

Design and Usage of Learning Materials
in a VCE Online Oncampus Educational Environment in the
21st Century

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Declaration

I certify that except where due acknowledgement has been made, the work is that of the author alone. The work has not been submitted previously, in whole or in part, to qualify for any other academic award. The content of the thesis is the result of work which has been carried out since the official commencement date of the approved research program. Any editorial work, paid or unpaid carried out by a third party is acknowledged. All research procedures reported in this thesis have been approved by the RMIT School of Education and School of Graduate Research RMIT University. RMIT ethics procedures and guidelines have been followed and approved by the RMIT University Human Research Ethics Committee.

Signed...

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Date.....20th May 2014.....

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List of Acronyms

AARE	Australian Association for Research in Education
ATAR	Australia Tertiary Admissions Rank
DEECD	Department of Education and Early Childhood Development
DET	Department of Education and Training (Victoria)
ENTER	Equivalent National Tertiary Entrance Rank
ICT	Information Communication Technology
DLO	Digital Learning Object
IWB	Interactive White Board
VCAA	Victorian Curriculum & Assessment Authority
VCE	Victorian Certificate of Education
VET	Vocational Educational Training
VICTER	Victorian Tertiary Entrance Rank
VTAC	Victorian Tertiary Admissions Centre

Abstract

This thesis examines information technology teachers' perceptions of the online oncampus learning materials they create to deliver the Information Technology Study of the Victorian Certificate of Education (VCE) in Australia. In this research 'online oncampus' describes teachers working in an online environment and face-to-face with students who are studying in the classrooms of secondary colleges in the traditional oncampus fashion.

Information technology teachers were developing their teaching practices during the last decade of the twentieth century and into the first decade of the twenty-first century. Their classrooms continue to be the first to adopt each new technology and they are in the front line of pedagogy development/evolution. As a consequence of these changes the following research question was identified as a focus for the study: Are the major learning theories of the late twentieth century (Behaviourist, Cognitive and Constructivist) evident in the online learning materials of VCE online oncampus learning environments?

As a framework for the research, major learning theories were explored from relevant literature about the design of online instructional material. Three theoretical constructs of interest were identified: Behaviourist Learning Theory; Cognitive Learning Theory and Constructivist Learning Theory. The study was designed to investigate how information technology teachers incorporate these three theoretical constructs in the development of their online oncampus learning materials. The study used a constructivist paradigm, qualitative methods and an instrumental case study of eight purposively selected information technology teachers.

Data were collected from each participant during in-depth interviews. Follow-up discussions were conducted to confirm interpretations presented in individual case reports. When the data were analysed across the collective cases five themes were identified and the frequency of occurrence of behaviours associated with the theoretical constructs were recorded.

The findings indicate that individual information technology teachers are innovative practitioners who have, in response to a rapid uptake of communication technology by their teaching institutions and their students, become life long learners. In addition that information communication technologies influence teaching practices which in turn influence the information communication technologies chosen by information technology teachers. Further that information technology teachers rely on pedagogies that are familiar.

Considered collectively, the information technology teachers' responses evidence the influence of Behaviourist, Cognitive and Constructivist theories of learning. This study presents a range of perspectives about the design of online instructional activities for Year 12 VCE information technology students and the online oncampus environment information technology teachers create to support those learning activities.

Chapter 1 Introduction

1.1 Aim

The initial appearance of computers in schools beginning in the late 1980s, followed by the widespread uptake of the Internet (and more recently mobile technologies) has placed information technology teachers in the front line of pedagogy development/evolution. This research is a study of the online on-campus instructional environments created by information technology teachers for the Information Technology Study of the Victorian Certificate of Education (VCE) in Australia. The learning environment is examined through a lens constructed from selected components of Behaviourist, Cognitive and Constructivist learning theories in the belief that, these are the major theories impacting on the practice of the selected experienced teachers, who have developed their professional practices during the last decade of the twentieth century and the first decade of the twenty-first century.

This study interrogates the perceptions of eight information technology teachers operating in an environment controlled by a state government curriculum authority and where a learner's achievement is determined by public examination. It examines the influence of the selected learning theories and the impact of information technology. It aims to identify possible uses of these learning theories in a credentialed online oncampus learning environment. In particular, it aims to examine the contention, suggested by an initial field study, that pedagogy derived from Behaviourist, Cognitive and Constructivist learning theories is tailored by the information technology teachers who are working within the constraints of the VCE, in an online oncampus learning environment.

1.2 Significance

This research utilises components of Behaviourist, Cognitive and Constructivist learning theories as a framework to study the influence of the selected pedagogies in an environment where the curriculum is prescribed and the uptake of computer technology is mandated. The significance of this study is its focus on the online learning environment created for the VCE information technology study. In particular, where the learning outcomes and assessment conditions are mandated by a state curriculum authority, as they are in the case of the VCE, teachers developing new pedagogy for an online environment will opt for, and rely upon, learning material and teaching strategies underpinned by 'tried and true' components of Behaviourist, Cognitive and Constructivist learning theories.

1.3 Research Question

This research considers experienced information technology teachers' perceptions of the online oncampus learning environment in a period where computers, the Internet and finally, mobile technologies, have been introduced to classrooms. Because of the particular expertise of information technology teachers, they have been among the first to adapt their teaching practice to the online oncampus environment. Thus examination of their views will provide insights into a changing teaching practice. The main research question is: Are the major learning theories of the late twentieth century (Behaviourist, Cognitive and Constructivist) evident in the online learning materials of VCE online oncampus learning environments?

1.4 Methodology

The research methodology sets out how this study was conducted and provides details of the individual and collective case study components of the research. These components include:

- The identification of experienced teachers of VCE information technology in the teachers' email list www.edulist.edu.au and at the conferences of the Victorian Information Technology Teachers Association www.vitta.org.au as possible participants in the study. The final group of eight teachers was chosen in the belief that these teachers reflected on and contributed to the environment under consideration and were in the best position to provide informed opinions.
- This is a study of phenomena in the natural world. It is conducted within a constructivist paradigm following qualitative methods and using an instrumental case study of eight purposively selected information technology teachers.
- The development of a framework based on elements that Ally (2004), and Burton, Moore and Magliaro (2004) associate with Behaviourist, Cognitive and Constructivist learning theories to examine the data collected from the respondents. This data comprised interview responses, online instructional activities created or used by the participants, and advice given to other teachers using the teachers' email list.

- The development of a semi-structured questionnaire, which allowed the unique experience of each respondent to be heard. The final format of the questionnaire covered the demographics of the VCE component of the secondary college and perceptions of the VCE oncampus online learning environment in the past, present and future. The questionnaire was sufficiently standardized to allow for comparisons across cases to be made.

1.5 Limitations

The interviews and data collection for this study were conducted over a four year period during the accreditation of the *Information Technology VCE Study Design* in Victoria, Australia, VCAA (2006a). The findings relate to that period and are bounded by the following limitations:

- The demographics of the VCE component of each college as the respondent described them during the interviews.
- The conclusions drawn from the analysis of responses and accompanying artifacts are the limited generalisations based on a study of eight teachers of VCE information technology and informed by conversations with three other teachers willing to participate as specialist consultants.
- Each case report is derived from a particular teacher's response to the local online oncampus learning environment. It is an individual's unique perception and the context must be considered when comparing the results with other studies.
- The theoretical framework used to examine the data collected from participants is derived from three theories of learning (Behaviourist, Cognitive and Constructivist) discussed in research by Ally (2004) and Burton Moore and Magliaro (2004) and other theories largely restricted to these theories of learning.
- The findings are derived from the interpretations of data made by the researcher who, like the participants is an experienced VCE information technology teacher. While an informed inquirer who is already familiar with the environment brings richer knowledge to the study, there is the potential for him/her to miss what is obvious.

1.6 Summary

This research is presented in six chapters.

Chapter One

Chapter One provides a rationale for the research. It states the aims of the study and outlines its significance. This introductory chapter aims to establish the background for research into VCE information technology teachers' perceptions of the online oncampus learning environment in Victoria, Australia.

Chapter Two

Chapter Two describes the context in which the respondents operate. The widespread uptake of computers, the Internet and mobile communication technology are considered in relation to the influence of Behaviourist, Cognitive and Constructivist theories of learning. This chapter considers components of these three learning theories, which Ally (2004) and Burton Moore and Magliaro (2004) identify as significant in the general development of computer based instruction and online learning. It also considers which components are useful in examining the data.

Chapter Three

Chapter Three explains the research methodology. It discusses qualitative methods selected and the assumptions supporting the decision to employ an instrumental collective case study. It provides a rationale for following purposive sampling procedures, and for the decision to present individual case reports. This chapter also considers selected current research used to interpret the data collected for real-world manifestations of theoretical constructs associated with components of Behaviourist, Cognitive and Constructivist learning theories.

Chapter Four

Chapter Four presents examples of the data for individual cases together with analysis of the responses recorded during the interviews. The unique responses of each of the information technology teachers are presented in the form of eight individual case reports. Each report covers emergent themes and evidence of behaviours associated with selected components of Behaviourist, Cognitive and Constructivist learning theories.

Chapter Five

Chapter Five provides a report on the analysis of responses across the eight cases. It presents the findings together with the interpretation of the data collected as a collective case report. This report provides a synthesis of findings from emergent themes and evidence of behaviours associated with selected components of Behaviourist, Cognitive and Constructivist learning theories.

Chapter Six

Chapter Six presents the conclusions of the research in response to the research questions. It argues that Behaviourist, Cognitive and Constructivist learning theories have each found a role in an online learning environment, where instruction is delivered on campus and learning outcomes are constrained by the VCE Information Technology study. It also identifies areas of interest that require further study.

Chapter 2 Literature Review

2.1 Introduction

This research investigates the design and use of learning materials in an online educational environment in the 21st Century. The literature review encompasses three broad areas: the foundations and development of major learning theories in the 20th Century; theories underpinning the design of educational material for online and oncampus use in the first decades of the twenty-first century and models of infrastructure to utilise information and communication technology in the learning experience. A study of these three areas provides the background for an examination of the content of instructional material and the strategies teachers and their institutions employ to deliver curriculum.

The most recent theories of student learning and teacher learning and practice are examined in the context of the Internet and the overwhelming impact this technology has had on society, communication and education. Particular attention is directed towards theoretical concepts developed to explain and predict the influence of the Internet on current teaching and learning.

This review of literature begins with a brief account of early theories of instruction, including the foundations of pedagogy in western society and the development of notions of empirical and rational science. The second section illustrates three major pedagogies of the twentieth century as they are applied in the context of the Internet. A purposively selected group of research papers are included because they provide examples of possible approaches to research methodologies that examine the influences of the Internet on teaching and learning. The third section examines research findings covering the role of teachers, the design of instructional material and selection of ICT tools in an online education environment. The final section presents an overview of the conclusions from the research examined.

2.2 Early Theories of Instruction

In the literature covering the long history and meandering development of teaching and learning many theories have been put forward, discussed, examined, championed and exhaustively questioned. Beginning with the early Greeks, Cottingham (1984) tells us that pedagogy, or the theory of how to teach, started as soon as teachers began to be paid for instructing the children of the powerful and wealthy. Much of the contention in these very early educational debates revolved around two opposed notions of how students acquired knowledge.

The first concept was of pre-existing or innate knowledge. It was proposed by early philosophers Socrates and Plato. An account of Socrates' beliefs comes from a dialogue written by Plato. Hummel (2004) describes it as a conversation "in which two main speakers Socrates and Meno, discuss human virtue: whether or not it can be taught, whether it is shared by all human beings and whether it is one quality or many" (p. 1). In this dialogue Socrates teaches a young slave a principle in geometry to demonstrate to Meno the idea that certain knowledge is innate. "Socrates later steers the discussion to [the nature of human knowledge] epistemology, . . . [stating] that knowledge is neither learned nor taught, but recollected from past lives and extracted from a person's soul ("psyche") by the dialectical method of questioning" (p. 4). Later in the dialogue Socrates elaborates on his idea drawing a distinction between what he calls 'true beliefs' and 'knowledge'. True beliefs become more valuable when they are 'tethered' by processes of reason and justification and converted into knowledge. This Hummel (2004) tells us, forms the basis of the "pre-eminent philosophical definition of knowledge as justified true belief" (p. 3). Cottingham (1984) in *Rationalism*, argues that Plato also believed knowledge is innate, declaring "a teacher will be unable to get a child to learn the simplest mathematical principle unless that child already possesses an innate grasp of the underlying principles and connections involved" (p. 27).

In the third century BC, following Socrates and Plato, Aristotle and others, challenged the concept of innate knowledge or the process of 'reminiscence' - recalling knowledge from a previous life. Aristotle believed that knowledge is obtained through the sensory perception. A number of quotations from Aristotle are used in a review of literature commissioned by UNESCO (1999), to illustrate the distinction between notions of how learning of practical skills and theoretical knowledge occurs. Competency in a practical skill for example, requires practice at that skill: "for the things we have to learn before we can do them, we learn by doing them, e.g. men become builders by building things and lyre-players by playing the lyre. . . . [in summary] Education through habit is concerned with three notions . . . imitation, experience and memory"(p. 7). By contrast, acquiring theoretical knowledge or "Education through reason . . . is concerned with the universal which surpasses all experience because . . . Men of experience know what that thing is but they do not know why the thing is Men of learning know why a thing is" (p. 8). Importantly, these seemingly competing theories of how learning occurs, are now believed by many observers to complement each other.

Aristotle also believed that a form of pre-existing knowledge could enhance the learning process but for Aristotle it resulted from prior experience of the real world. Aristotle summarised in a report commissioned by UNESCO (1999) believed "all teaching given or

received by means of reasoning derives from pre-existing knowledge . . . [it is] the perception of a concrete fact or knowledge of a term that signifies that fact” (p. 9). Cottingham (1984) similarly notes that Aristotle’s theory of learning does not allow for innate knowledge, it is adamant that what we know arises from sensory experience of the world.

2.2.1 A Scientific Way of Learning

In the last section the educational ideas of Socrates, Plato and Aristotle were briefly recounted to illustrate how the seemingly opposed concepts of innate knowledge and sensory perception fit into the history of pedagogical development. Aristotle’s theory that knowledge is acquired by sensory perception and enhanced by reasoning is further examined to illustrate the evolution of pedagogies associated with empirical and rational scientific methods.

Cottingham (1984) describes how Aristotle’s concept of knowledge divided into empirical and rational science. Empirical science, at one extreme, relies on practical experience without reference to theory while rational science produces knowledge based on reasoning alone.

Cottingham’s brief descriptions of the competing notions are presented here to help distinguish between two important beliefs underpinning scientific method. Empirical science “observes and documents and provides an account of science . . . [it is] based on the notion of observed correlations . . . between different phenomena” (p. 60). Rational science, by contrast explains why the observed behaviour occurs - the rationalist view insists that empirical correlations describe science but “do not explain why objects behave as they do . . . ” (p. 60). In the twentieth century, both of these seemingly opposed concepts became ‘tools’ within the positivist paradigm, to be used as the teacher, learner or researcher deemed appropriate.

2.3 Theories of Instruction in an Online Environment

2.3.1 An Overview of Theories

The development of pedagogy in the twentieth century is outlined under the headings of three main theories: Behaviourist, Cognitive and Constructivist. To provide a context appropriate for this study, each pedagogy is examined in terms of the findings from Foundations of Educational Theory for Online Learning a study by Ally (2004). This is a study of online instructional materials for an online oncampus learning environment at the beginning of the twenty-first century.

At the beginning of the twentieth century mainstream learning theory in western society was based largely on pedagogy developed from concepts inherited from Aristotle. The first of these, Behaviourist theory, derives from observations of learners’ behaviours. From Ally (2004), Behaviourists contend that learning causes a measurable (observable) change in

behaviour and that change is caused by external factors such as reading, teacher instruction and audio or visual material. This 'definition' is developed in Ally (2004) from an examination of the works of educational theorists including Dewey, Pavlov, Thorndike Watson and Skinner. Behaviourist theory when referred to in this research will, in general, assume this definition presented in Ally (2004). However, it is worth noting that Cottingham (1984) sounds a word of warning to those who base any later theory on observation or empirical science. He contends that empirical science is ultimately, logically flawed, because it would have us draw scientific laws from repeated past observations that set up "habitual expectations [and that by this mechanism] a false inevitability of events is generated" (p. 80).

The second theory of learning Cognitive Psychology, was developed in the second half of the twentieth century when, as in the time of Aristotle, the need to explain the observed learning behaviours arose. Piaget (1950) and others drew on emerging theories of psychology to explain learning in terms of the working of the human brain. Cognitive Psychology Learning Theory, contends that learning is an internal process involving the use of memory, motivation, thinking and reflection. Vygotsky (1930) had linked cognitive development to the learner's understanding of signs and symbols of the culture in his/her interactions with adults.

Ally (2004) presents Cognitive Psychology Learning Theory as a theory where the amount of learning depends on the "processing capacity of the learner, the amount of effort expended during the learning process, [and] the depth of processing . . ." (p. 7).

Finally, at the end of the twentieth century a Constructivist learning theory emerged which is based on the notion that cognitive activity is prompted by stimuli from the environment that are not represented in the mind. In *Growing up Constructivist: Languages and Thoughtful People*, von Glasersfeld (1995) described radical constructivism as "an unconventional approach to the problems of knowledge and knowing. . . . knowledge no matter how it is defined is in the heads of humans . . . the thinking subject has no alternative but to construct what he or she knows on the basis of his or her own experience" (p. 1). In particular that cognitive activity is not separate from context. Constructivist learning theory contends that learners interpret information and the world according to their personal reality. Ally's (2004) conclusion is that they learn by observation, processing, and interpretation, and then by personalizing the knowledge. The researcher notes that the development of the Constructivist pedagogy coincided with widespread uptake of the Internet, massively extending the original notion of a context. Context now, must include the virtual environment along with the old reality of 'individual to individual' communication. For education this has had at least two major consequences: cognitive activity can now be prompted by stimulus from the virtual

environment, and an individual's personal reality now includes strangers in cyber space. Winn (2004), discussing theories which take this new virtual world into account highlights Moore's Distance Theory which defines the relationships between 'learning and distance' and 'distance and dialogue'. These are important factors in the design of online instructional material because the Internet separates the mental and the physical in ways that are rapidly evolving. In Section 2.4.2.2 this is shown to apply to the timing as well as the location of cognitive action. Winn (2004) concludes that cognitive activity is not simple and that it results from the dynamic interaction between two complex systems- a person and the environment. The components of the online learning environment society, tools and individuals are also discussed in Section 2.4.2.2.

The 2003 Melbourne Conference of the International Federation for Information Processing (IFIP), included a number of papers dealing with the developmental history of pedagogy. These mostly support the uptake of the Constructivist pedagogy in the belief that it fits with features associated with the online learning environment. Amongst the papers collected in *Information and Communication Technology and the Teacher of the Future* edited by Dowling and Lai (2003), there were papers arguing that pedagogy in online environments faced the "challenge of preparing students to live, learn and work successfully in today's knowledge based society" (p. 193). In these papers, the curriculum documents produced by various state education departments reflected what one author called "the push for an education system underpinned by synergies between technology and the ideas of social constructivism" (p.194). Dowling and Lai (2003) summarise the notion that "knowledge does not lie outside the human sphere in a pre-existing form . . . instead [it] is more likely to arise from human experience of the world via the senses" (p.193). In the theory of social constructivism "the psychological process by which human experience . . . [is] converted to knowledge of the world . . . [is] a socially mediated act" (p.193).

At the end of the first decade of the twenty-first century Gredler (2008) examined the influence of the Internet on pedagogy. In a summary of the differences between Piaget and Vygotsky she characterises Piaget as addressing "the development of logical thinking in the form of causal relationships about events . . . [grounding his research in] the individual child's manipulation of and interaction with objects in the environment" (p. 263). Vygotsky, she explains observed that children "demonstrate their understanding of the role of cultural signs (psychological tools) in addressing cognitive tasks analysed" (p. 263), For Vygotsky an adult is an 'ideal form' and the signs and symbols of one's culture were essential components in the development of "higher psychological or mental processes [such as] self organised attention, categorical perception, conceptual thinking and logical memory" (p. 263). The researcher

believes that many of the components identified by Piaget are found in the presentation colour and sequencing of online instruction material and the use of trial and error manipulation of virtual objects by an individual learning in a virtual environment. Also Gredler's conclusions, drawn from Vygotsky's argument, are pertinent in an online learning environment where collaboration is enhanced by interactive tools such as social media and interactive whiteboards.

In summary, elements of learning behaviour are explained successively during the 20th century by Behaviourist, Cognitive and Constructivist theories. With the advent of the Internet these three learning theories have found new applications in the context of online learning. They are examined in detail in that context in the following sections.

2.3.2 Behaviourist Theory

Ally (2004) highlights the distinction between Behaviourist theory and more recent theories when he states "it is the observable behaviour that indicates whether or not the learner has learned something, and not what is going on in the learner's head" (p. 7). On the basis of this assumption he lists the implications for organizing an online environment along Behaviourist lines.

- Learners are informed of learning expectations so they can assess their own performance.
- Testing is integrated into learning experience to ascertain achievement and provide feedback.
- Material is sequenced usually from simple to complex, to promote learning.
- Feedback allows learners to monitor their own progress and determine an appropriate action.

Ally (2004) notes that many early examples of computer instruction were influenced by the Behaviourist school of thought and exhibit these features.

In another study entitled *Behaviourism and Instructional Technology* Burton, Moore and Magliaro (2004) pinpoint an important problem for later discussion when they conclude for "behaviourists, the same principles that account for simple behaviours also account for complex ones" (p. 10). To account for the complexity encountered Behaviourist Learning Theory is divided into four sub-categories of learning behaviour: respondent learning, operant learning, observational learning and methodological behaviourism.

2.3.1.1 Respondent learning

Respondent learning is the first sub-category of Behaviourist Learning presented. Burton, Moore and Magliaro (2004) explain its derivation from the theory of conditioned response associated with the techniques of Ivan Pavlov. Learners are gradually trained to respond to what is initially a neutral stimulus such as a whistle. If for example, the whistle is blown every day when morning tea is served, then learners associate the whistle with an expectation of morning tea and they respond accordingly. The respondent learning model provides the theoretical basis of advertising and propaganda in that it produces emotional and physiological responses to stimuli. In an educational environment Burton, Moore and Magliaro note the possibility of these unwanted associations and negative responses as a problem and that “in designing software, video, audio . . . careful attention is paid to the aesthetic features of the medium to ensure motivation and engagement” (p. 10). The importance of identifying “factors that might influence the learner’s attitude and level of participation in carefully designed instructional events is a whole area of study in itself called “methodological behaviourism” (p. 10). It is examined in detail by Burton, Moore and Magliaro in a section headed ‘Computers as Tutors’ because it provides the theoretical basis for what Burton, Moore and Magliaro (2004) call “instructional technology” (p. 12).

2.3.1.2 Operant Conditioning

The second sub-category of Behaviourist Learning theory presented by Burton, Moore and Magliaro (2004) is termed operant conditioning. It is based on the notion that automated learning can be successfully designed because there is a “relationship between stimuli that preceded a response and stimuli that followed a response and the response itself” (p. 10). There are three steps in this learning process: the antecedents (cues or signals); operands and consequences. In this model of instructional design the role of the educator is to control the sequence of cues, operands and consequences so that they are in line with the educational goal. The consequences of a learning activity can be monitored (observed) and the cues repeated in a feedback loop known as “schedules of reinforcement” (p. 11). In the design of much of the learning material for an online environment, the three step sequence of ‘cue-operand-consequence’ is the central process. Burton, Moore and Magliaro (2004) identify the sub-procedures associated with complex learning, problem solving and transfer and examine them in terms of the processes described by the theory of operant conditioning. First, Burton, Moore and Magliaro (2004) explain that complex learning “is developed through the learning of chained behaviours . . . through practice and contiguity, the consequence [of one learning step] takes on a dual role and becomes the stimulus [for the next step]” (p. 12). Secondly, Burton, Moore and Magliaro (2004) describe problem solving as a learner’s “tactical readjustment to changes in the environment . . . [a] trial and error experience” (p. 12). Thirdly,

Burton Moore and Magliaro (2004) explain that transfer “involves the replication of identical behaviours from [one] task . . . to a new task that has similar elements” (p. 12). All three processes, complex learning, problem solving and transfer rely on repeated practice of specific skills and detailed feedback to tailor the tasks to the learner’s need for a particular reinforcement. Computers, from the very first were viewed as ideal tools for this process.

2.3.1.3 Observational Learning

The third sub-category of Behaviourist Learning Theory is observational learning. It is based on the idea that new behaviour can be learned by observing the behaviour of others. Examples cited in Burton, Moore and Magliaro (2004) include animals observing other animals solving simple problems being able to solve similar problems when they were in identical cages to the observed animals. It also includes children learning when they observed other children and adults modelling a behaviour. The process also accounts for the *vicarious* learning attributed by Burton Moore and Magliaro to Bandura (1978), who named it Social Learning Theory. In Social Learning Theory, learners observe “other people’s behaviour and its consequences for them” (p. 12). The idea that watching live or filmed performance or descriptions of performance (called symbolic modelling) and the consequences are also considered observational learning. This is an important categorisation when the examples of the content of web-based learning are examined in Case Reports, Chapter 4.

Burton, Moore and Magliaro (2004) identify four components of observational learning: attention, retention, motor reproduction and motivation. These are presented in Table 2.1 below along with descriptions of characteristics that may be used to identify them in the subsequent analysis of learning materials and ICT tools.

Table 2.1 Components of Observational Learning

Components	Observed Behaviours Burton, Moore and Magliaro (2004)
<u>attention</u>	observer’s sensory capacity (perceptual set)
<u>retention</u>	response patterns and how they are represented in memory in symbolic form
<u>motor reproduction</u>	organisation of responses on the basis of feedback
<u>motivation</u>	evaluative judgments that learners make about what they have learned and how it will affect their performance.

2.3.1.4 Methodological Behaviourism

Burton, Moore and Magliaro (2004) tracing the history of instructional learning state “Most of the earlier work in instructional technology followed what was known as the methodological behaviourist tradition” (p. 13). This started with teaching machines of the 1970s, included the use of programmed audio visual instructional materials and the military’s use of training films

in extensive studies where the students' responses were observed and analysed. Finally, the most recent example is Personalized System of Instruction (PSI) models which use the Internet. Burton, Moore and Magliaro also cite the experiences of the Open Universities which now use computers largely to manage the complex conferencing and administrative procedures associated with employing tutors. They identify the online question and answer (Q and A) tutorial as "the most useful feature" (p. 26).

Finally, in a summary of the findings from their wide ranging examination of literature, Burton, Moore and Magliaro (2004) identify three strengths computers can bring to the Behaviourist pedagogy. Acting as tutors, computers provide control of the sequence of material and they can be programmed to respond to learners' questions. In the development of self-paced instructional material computers are able to automatically determine and monitor when learners need help, select what type of help and with the Internet provide appropriate help. Burton, Moore and Magliaro characterise the Behaviourist mechanism as relying on the learner building associations based on the simplest unit they have learned in an environment which provides contiguity and utilizes repetition. In an environment where computers control the sequence of material, monitor the student's progress and provide appropriate help, the learners are able to generalize (respond the same way to similar stimuli) and discriminate (respond differently to varied stimuli). Burton Moore and Magliaro view the capacity to discriminate and to generalize as central in the processes that enable learning to be adapted and transferred to other environments.

It is noted that Behaviourists such as Skinner (1965), Watson (1913) and from Saettler (1990) Edward Thorndike, were aware of the complex interaction between learners and their environments. Skinner (1965) for example gave an early warning against relying on a simple definition when he observed that "Behaviour is a difficult subject matter, not because it is inaccessible, but because it is extremely complex" (p.15). Seven years later Skinner (1972) was more optimistic or determined when he observed "No one knows the best way of raising children . . . teaching or making people creative, but it is possible to propose better ways . . . and support them by predicting and eventually demonstrating more reinforcing results" (p. 145).

Harasim (2012) characterises Thorndike as "interested in the association or connection between sensation and impulse, and [that he] studied learning connected to action" (p. 34). Thorndike is described by McLeod (2007) as "famous in psychology for his work on learning theory that lead to the development of operant conditioning within behaviourism" (p. 4). She also recounts how Thorndike developed intelligence tests for the American Military and

recognised the need for diagrams and pictures to cater for soldiers who could not read well. It is noted that while Thorndike's theories may have pointed towards elements explained by Cognitive theory he is a behaviourist because as Harasim notes, his theory of Connectionism is based on the notion that "learning could be adequately explained without referring to any unobservable internal states" (p. 34). Watson is described by McLeod as "the first American psychologists to use Pavlov's ideas" (p. 4). Harasim explains that Watson argued for precision, prediction and repetition as the foci of instructional design and that this theory of learning was reinforced by the necessities of training soldiers during the Second World War. His theories of learning were controversial, because as Harasim recounts Watson believed that "terms such as consciousness, mind or images do not have a place in psychology" (p. 34).

In the concluding remarks of their examination of research findings of 'behaviourism and learning technologies', Burton, Moore and Magliaro (2004) champion Behaviourist theory over Cognitive and Constructivist theories, stating that "it is rich enough to account for both"(p. 26). They also argue that Behaviourist theory is best suited to the learning environment offered by the Internet. The conclusion would appear to be unsupported in the material they present because the research findings examined by Burton, Moore and Magliaro are overwhelmingly concerned solely with Behaviourist theory. In the next section the research findings of Cognitive theory and learning technologies are presented.

2.3.3 Cognitive Psychology Learning Theory

In the research by Ally (2004), Cognitive Psychology Learning Theory (CPLT) contends that learning is an internal process involving the use of memory, motivation, thinking and reflection. The supporters of CPLT argue that the amount of learning depends on the "processing capacity of the learner, the amount of effort expended during the learning process, the depth of processing . . ." (p. 7). Ally (2004) lists the implications of utilising CPLT when designing strategies for online learning. The implications are summarised here:

- Strategies should provide learners with information carefully coloured, placed and paced to assist them perceive and transfer it to working memory.
- Information should be grouped into generalized categories using information maps.
- Strategies should help learners construct a link between information in long term memory and new information.
- Strategies should require learners to apply, analyse, synthesize and evaluate information.
- Learning materials should be provided to suit various learning styles.
- Support materials should be appropriate to the learner's preferred style.
- Learning material must be constructed to motivate learners.

These implications are considered in Methodology, Chapter 3.

In the years leading up to this study and during the data collection and analysis period, a number of theorists including Paivio (1990), Baddely (2000), Sweller (2008) and Mayer and Moreno (1998) developed cognitive theories of learning that described human thought processes using terminology associated with computer processes. For example, Paivio's "structural representations of dual coding theory refer to relatively stable long-term memory information corresponding to perceptually identifiable objects and activities, both verbal and non-verbal" (p. 54). Mödritscher (2006) then drew on Paivio's dual code theory and stated that "information should be presented in different modes to accommodate individual differences in coding and to facilitate transfer to long term memory" (p. 6).

Researchers Mayer and Moreno (1998) based five design principles for multimedia learning on Mayer's (1997) theory of multimedia learning. The first principle stated simply is that "it's better to present an explanation in words and pictures than solely in words" (p. 2). Another researcher, Baddely (2000) proffered in a paper with the techno-speak title *The episodic buffer: A new component of working memory*, that "the buffer not only provides a mechanism for modelling the environment, but also for creating new cognitive representations, which in turn might facilitate problem solving" (p.421). Later Sweller (2008) drawing on the work of many cognitive theorists including Mayer and Baddely identified the 'split-attention' principle where data from two or more sources "are unintelligible in isolation and can only be understood in conjunction with one another" (p. 375).

Finally Swann (2013) in a large scale study devised to examine learner responses to courses developed by a commercial e-learning provider, cited Sweller's (2008) 'split-attention principle' and Mayer and Moreno's (1998) 'multiple representation' principle when he argued that "using the audio system for verbal communication and the visual system for imagery is a more efficient division of labour" (p. 62).). Swann also drew on Baddely's (2000) ideas when he stated "Text on the screen does not flow into the visual memory buffer automatically. Conscious effort is required on the part of the learner to read" (p. 62).

Winn (2004) in *Cognitive Perspectives in Psychology* presents and challenges the widespread view that human thought processes equate to computer processes. This view is based on the notion that "people represent information in their minds as single or aggregated symbols and that activity consists of operating on these symbols by applying to them learned plans" (p. 79). To challenge this notion he explores developments in the related field of Artificial

Intelligence (AI) and lists five assumptions underlying what he believes is a linear or simplistic view:

- There is a direct relationship between internal representations and the external world.
- The mental images look in the ‘mind’s eye’ like the phenomena from which they were created.
- There is a physical and phenomenological separation between the mental and physical world.
- The images created represent objects and events.
- The images are altered by mental processes and translated into behaviours and outcomes that can be observed in the external world.

Winn (2004) believes that it can be demonstrated that cognitive activity is prompted by stimuli from the environment that are not represented in the mind and cognitive activity is not separate from context. From these results he concludes that cognitive activity is not simple and that it results from the dynamic interaction between two complex systems namely: a person and the environment.

In the Cognitive theory of learning, these two, dynamic and interacting systems are explained in terms of four frameworks. They are presented as the major components of Cognitive learning in Winn (2004) and are known widely as: System Theory; Biological Frameworks; Cognitive Neuroscience and Neural Networks. They are described briefly here to provide a basis for the later discussion of any characteristics identified in online learning material that might be attributed to Cognitive theory.

2.3.2.1 System Theory

System theory provides a mathematical model to represent the mechanisms of learning with “a focus on cognition and systematic changes . . . [and where] the learner and the environment are in constant interplay” (p. 80). In System theory, insights are gained by graphing the changes in learners and their environments and expressing the findings as complex equations.

2.3.2.2 Biological

In the Biological framework, Winn (2004) tells us we are “living beings who obey biological laws and operate through biological processes” (p. 81). In a statement echoing Aristotle's challenge to the notion of ‘innate knowledge’ he reminds the reader that the human mind is “an emergent property . . . not something that has divine or magical . . . properties” (p. 81). This proposition also links to the basic premise of McLuhan (1967): that electronic media provides an extension to the human nervous system and by this means extends our capacity to

learn when experiencing the environment. Winn (2004) summarises the biological framework in the context of the Internet, “Technology has advanced to the point where we can construct complete environments where students can learn” (p. 81).

2.3.2.3 Cognitive Neuroscience

Cognitive neuroscience, as discussed in Winn (2004), is based on considering simultaneously two areas of study: the workings of the human brain and the exact processes entailed in learning. It is argued that with greater understanding in these two fields, concepts such as ‘learning styles’ and ‘right brained phenomena’ which currently influence educational literature will be more accurately addressed. Winn concludes by noting that current ongoing research into the central nervous system aims to determine how the “brain exerts control over a person’s state in [their] environment” (p. 81). This again is an interesting convergence of McLuhan’s (1967) notion of the individual’s senses extended by electronic means, and the creation of a virtual environment.

2.3.2.4 Neural Networks

The fourth component, neural networks is characterised by Winn (2004) as using the same metaphor to describe the workings of the human brain and the workings of computers. “Networks represent information through the way their units are connected. . . . the changes in these connections are themselves the way learning takes place. What is known and the ways knowledge is changed are one in the same thing” (p. 81).

Later in the data collection stage of this study Dennen and Burner (2008) reported on studies which focussed on “Cognitive apprenticeship . . . a process by which learners learn from a more experienced person by way of cognitive and metacognitive skills and processes” (p. 426). Their study included software-based scaffolding and they identified the following two broad purposes that it serves. First software-based scaffolding provides a structure to guide learners through a task and secondly it creates a scenario in which a problem can be explored.

The section of Dennen and Burner’s study which focused on metacognition examined the influence of providing automated prompts in the form of “visualisation components and expert analysis and hints” (p. 433). Their findings suggest that learners “must have sufficient metacognition development to identify their own learning needs” (p. 433). Further when the different learner responses to automated prompts were examined it was found that learners preferred generic prompts to directed prompts (p. 434). They concluded that, in general, for an automated learning task to be successful its goals must align with those of the learner.

In summary, the widespread view that human thought processes equate to computer processes, and the detail found in System Theory, Biological Frameworks, Cognitive Neuroscience and Neural Networks support Winn's (2004) observation that cognitive activity is not separate from context. Winn concludes that cognitive activity is not simple and that it results from the dynamic interaction between two complex systems- a person and the environment. This is a conclusion that leads to concepts associated with Constructivist theories of learning.

2.3.4 Constructivist Theory

Constructivist learning theory presented in the evaluation of online learning by Ally (2004), contends that learners learn best in two circumstances: when they can contextualize what they learn for immediate application and when they learn to acquire personal meaning. The study by Ally (2004) provides a summary of the implications for online learning which are listed here:

- Strategies should make learning an active process.
- Learners need opportunities to construct their own knowledge.
- An environment that encourages collaborative learning should be promoted.

They are confirmed in studies by Mödritscher (2006) and Harasim (2012). They can be added to the features that Ally (2004) identified as advantages of online learning.

- Access to up to date and relevant learning materials.
- Communication with experts in the field while working on the job.
- Feedback and directing learners to appropriate materials to achieve learning outcomes.

Taken together these advantages also match predictions found in the literature of social change and consequential educational change made earlier by Tofler (1970) and Drucker (1995). Both commentators envisaged a society based on knowledge and educational systems structured around the concept of learning as an ongoing process. In 1970, well before the Internet, Tofler declared that education based on a swap of old knowledge for new had ended because new knowledge itself was being superseded very quickly. He foresaw an environment characterized by what he called 'futureshock' and believed established educational institutions would soon require a major re-adjustment in curriculum. Drucker (1995) writing two decades later in the midst of the change, believed educational organisations would have to learn to function in the new knowledge-based society with knowledge itself a primary resource for individuals and for the economy. He believed learning institutions would have to rethink their way of organizing and identified the following three factors as likely to influence the way learning institutions would reconceptualise themselves. First, "anyone with any knowledge will have to acquire new knowledge every four or five years or become obsolete"

(p. 69) – which he saw as an active process. Secondly, “schools and universities will change more . . . than they have . . . [since] they reorganized themselves around the printed book” (p. 70) – this he saw as a collaborative processes. Thirdly, “every organisation will have to learn to innovate - and innovation . . . must be organized as a systematic process” (p. 71) which Drucker characterised as access to up to date ideas.

The predictions of Drucker (1995), together with the advantages of online learning listed in the Ally (2004) study, provide a broad framework for the examination of Constructivist theories of learning and their influences on instructional design. The lists of the implications for online learning made in Ally (2004) will also provide detailed matrices for the examination of all these theories of learning and their influence on instructional design in the data collected from the interviewees in this research study. The ideas of other major theorists/commentators, Gardner (1983), von Glasersfeld (2000), McLuhan (1967) and Piaget (1950) and Vygotsky (1930) are frequently mentioned in the literature reviewed. Their ideas will also be used to examine data for evidence of their influence on instructional design in online learning.

The first two theories, ‘multiple intelligences’ discussed in *Frames of Mind* by Gardner (1983) and ‘radical constructivism’ summarised in *Problems of Constructivism* by von Glasersfeld (2000) are both widely discussed theories of learning that influence current teaching practices. This study will explore the idea expressed in Gardner’s statement, “central to my notion of an intelligence is the existence of one or more basic information-processing mechanisms which can deal with specific kinds of input” (p. 64). It is of particular interest because a number of Victorian Secondary Colleges have programs where broad curriculum development strategies and professional development programs are based on the concept of ‘multiple intelligences’. This study will also consider the concept expressed in von Glasersfeld’s (1990) statement “knowledge is under all circumstances constructed by individuals . . . as an adaptation to their subjective experience” (p. 4). The notion of knowledge being both constructed and related to subjective experience is of interest in this study of online learning because the Internet has the capacity to provide students with an option of selecting their own learning environments and instructional modes.

The second two theorists are Vygotsky (1978) and Piaget (1950). Vygotsky introduced the concept of a ‘zone of proximal development’ where an immature learner can be helped to reach a higher developmental level with adult guidance. The influence of Vygotsky’s ideas on the creation of online collaborative learning environments is examined by Gredler in *Vygotsky’s Legacy* and considered further as the study progressed. Piaget, the second theorist,

described the functioning of intelligence and stressed the notion that ‘thinking is action’. He noted that “[it is] continuity which links operation with true action, the source and medium of intelligence” (p. 36). The relationship between consciousness, the type of action available to an individual student (using the Internet in this study) and learning will be considered further as this study progresses.

McLuhan (1967), a social commentator, is of interest because he linked computer technology to learning and human consciousness. He believed that our central nervous system has been extended or translated into electromagnetic technology and “it is but a further stage to transfer our consciousness to the computer world as well” (p. 71). This idea is of interest for this study as the rise of personal mobile technologies have an impact on education in general, Ally (2009), and perhaps the VCE classroom, in particular.

A conference paper *Teachers in the Mobile World* presented by Multisilta, Keiho and Ketamo (2003) documents the relationship between learners and the widely used mobile technology. They described “teacher centred instruction . . . in a mobile world . . . [where] learning will also be self directed to encourage social knowledge construction between students . . . ” (p. 260). The technology described in the 2003 research included Personal Data Assistants (PDA) and laptops operating in a campus centred wireless environment. The learning strategies and technologies taken together, fit well with the Constructivist view of learning in a number of features. They engage the learner in active work and rely on social interaction to maintain co-operative or problem based learning tasks, and they deliver information in an open ended format. Further, working in a collaborative electronic learning space requires self study skills, the ability to verbalise and the ability to create and share documents of “collective knowledge”. Multisilta, Keiho and Ketamo (2003) highlight a dilemma for those designing courses and planning infrastructure for an online environment when they state that collaborative networking must be made to work successfully with online learning which is a lone process, and within an assessment structure where certification is achieved by individuals not groups. Godinet (2003) summarises these seemingly conflicting notions and concurs with the Constructivist learning theory when she argues that designers of the online learning environment have to provide opportunities to learn without identified teachers and at the same time remember that learners need to interact with others because “cognitive conflict is necessary to construct one’s understanding and identity” (p. 233).

Finally, Keller and Suzuki’s (1988) ARCS model for motivating learners, provides a summary of design features from all three learning theories, that arguably could be used as a

checklist for designers of online instructional material. It is based on the notion, that to some degree, “learners are motivated by externally driven methods” (p. 16). Keller and Suzuki identify four design elements, that motivating-activities will employ. The first two, attention and relevance, are associated with the content and design of learning material, and the second two, confidence and success, with addressing learners’ cognitive needs. They are listed here with the following characteristic descriptors:

- Attention- material designed to capture the learners’ attention; an activity at the start
- Relevance- inform learners how the lesson will benefit them; contextualise the content
- Confidence- use strategies designed to give learners success; in a sequence of simple to complex activities
- Satisfaction- provide feedback on performance; allow learners to apply the lesson to real life.

The ARCS model and characteristic descriptors are considered in Cross-case Findings, Chapter 5.

2.4 Internet Based Learning: Research Findings

Caplan (2004) promotes the use of research findings in *The Development of Online Courses* stating that course developers “those who actually create the planned instructional materials with which students will interact, [should be] included in the course development processes from the beginning” (p. 175). Caplan argues that online instructional material and learning environments designed according to sound pedagogical principles will have the following features:

- the instructional designs of learning materials are stable because they have been based firmly on sound, proven learning theories
- these instructional designs will meet the institution’s identified internal and articulated external standards for quality, usability and interoperability
- appropriate media have been selected to meet these standards
- the technologies selected for course delivery are not superfluous – rather, the course design will exploit the unique characteristics of selected media in engaging and supporting both learners and teachers (such characteristics may include accessibility of content, multimedia, hyper-linking, multiple or global perspectives, ease of revision, accommodation of many forms of interaction, etc.) and
- the designs are practical and can be developed in a cost-effective and timely way (p. 175).

2.4.1 Transactional Distance

Hill, Wiley, Nelson and Han (2004) in *Internet Based Learning*, report on studies examining the changes in perception and understanding that occur when teachers and learners are separated. Hill, Wiley, Nelson and Han start with Moore's Transactional Distance theory which they initially simplify as less distance offers greater interaction and requires less structure whereas- greater distances require greater structure while offering less interaction. Hill, Wiley, Nelson and Han expand the notion of distance in Moore's theory so that "distance is not a geographical concept but rather a relationship between structure and dialogue" (p. 434). Their study then examines the two variables structure and dialogue, where the structure is the design of the course and the dialogue is the communication between teacher and student.

Hill, Wiley, Nelson and Han (2004) report on an analysis of Web Based Instruction (WBI) where the instructional material was examined to provide insights into the details of structure and dialogue. In the analysis of WBI, elements of structure were reclassified as infrastructure and determined to include:

- content expandability
- content adaptability
- visual layout.

The elements of dialogue were determined to include:

- academic interaction
- collaborative interaction
- interpersonal interaction.

These are considered in Chapter 3 Methodology.

Two additional elements: learner collaboration and learner autonomy are considered under the headings *Interaction* and *Control*. These are two of the four macro-factors identified by Hill et al (2004) as important developments in the context of web-based instruction derived from Moore's initial theory of transactional distance. They are considered important factors that need to be considered when describing the social context of online oncampus learning environments of this study.

2.4.1.1 Interaction

Much of the early research in the area of interaction was concerned with distance education and is examined to consider that which may be appropriate to oncampus interaction. Unlike distance education students studying oncampus can interact where and when they wish.

Hill, Wiley, Nelson and Han's (2004) report identifies four components of this interaction as *learner-instructor*, *learner-learner*, *learner-content* and *learner-interface*. They describe the findings recorded in each case and they are summarised here: the *learner-instructor* interaction is central to the feedback mechanisms and in providing motivation when it is needed; the *learner-learner* interaction promotes the exchange of ideas amongst students; the *learner-content* interaction defines the learning process and includes the 'plan' for providing resources and activities and the *learner-interface* interaction describes the learner's ability to use the hardware and software delivering the course.

2.4.1.2 Control

Hill, Wiley, Nelson and Han (2004) report on research findings from a range of online instruction 'scenarios' that indicate learner control is "critical in the development of effective learning environments" and that importantly for this study, "the web contains much more user control than other systems or educational software" (p. 435). Their report identifies two elements of control. The first element *internal* control, is often viewed by students as independence and the perception that "success is a result of personal accomplishment and effort" (p. 435). The second element *external* control, is the belief that success is based on factors outside the learner's control. Their report concludes that helping students adjust their perception of control from *external* to *internal* will increase the successful online learning experiences. Control they argue is to do with the individual, where the total environment or social context in which students operate, is an influencing factor.

2.4.1.3 Social Context

In Hill, Wiley, Nelson and Han's (2004) online environment, social context is made up of a number of complex elements. The first element, context, results from recognising that technology "may not be culturally neutral" (p. 435). As a consequence the context in which learning experiences will take place must be examined and prepared. The second element, a virtual space, is ideally created to provide the positive attributes of a physical learning space. This includes the feeling that others share the learning space and are a part of a learning collaboration. In a web-based learning environment, Hill, Wiley, Nelson and Han note that this includes "the degree to which the individual feels *real* by colleagues working in the online context" (p. 435). Central to learners feeling *real* was the type of response provided. Their examination of research findings concluded that audio feedback or hearing from a real person was the most important feature that "engendered a sense of presence" (p. 435). They suggest that incorporating sound and video into Internet-based learning experiences will have a positive impact on what the authors describe as Internet-enabled contexts.

2.4.2 Reports on Practice

2.4.2.1 Building Theory from Practice

Numerous reports of courses presented in an online oncampus environment are available. This section presents ‘findings of interest’ from a selection of studies initially chosen because their research methodologies exhibit strategies that are appropriate for the study of online and oncampus education. In general, findings from many of the early studies are in accord with a comment by Hill, Wiley, Nelson and Han (2004) who observed that many “initial attempts to move courses onto the Internet were solidly grounded [in] current practice, and generally attempted to perfectly duplicate face-to-face class experience online” (p. 436). In Hill, Wiley, Nelson and Han’s (2004) study, findings were presented from the following four areas of interest: course redesign; assignments; assessment and evaluation of student satisfaction and scalability. They are listed here with brief comments to provide starting points from which to examine more recent research.

Hill, Wiley, Nelson and Han (2004) concluded first that course redesign was largely concerned with scalability and in a number of instances this was reported as attempts to achieve higher student /teacher ratios “without sacrificing instructional quality . . .” (p. 436). Secondly, the experience of serving a few students with online facilities compared to serving many students in an online environment had consequences for managing assignments and assessments. In the early days these consequences were largely concerned with automating the marking and scoring processes. Thirdly, Hill, Wiley, Nelson and Han noted that moving courses online exacerbated difficulties of “plagiarism and authentication” (p. 437). This has become even more problematic in recent times particularly as the Internet is integrated into course structures. The fourth, in a more positive vein, was that the Internet has greatly facilitated the evaluation of student satisfaction. One evaluation cited by Hill, Wiley, Nelson and Han was based on document analysis of 154 online courses over a two year period. The courses were all tailored to the needs of adults and contained “small lectures, assigned readings’ and a significant online discussion component” (p. 437). They were analysed and grouped into three themes: faculty responsibility; facilitating discussions and course requirements. They are presented, for ease of comprehension in three Tables, 2.2, 2.3 and 2.4 below and considered in Methodology, Chapter 3.

Table 2.2 Faculty Responsibility

Components of Student Satisfaction	Characteristic Descriptors Hill, Wiley, Nelson and Han (2004)
Learners want	Prompt and specific feedback Criticism given by phone call not online
Learners do not want	Automated feedback

Table 2.3 Facilitating Discussion (Online)

Components of Student Satisfaction	Characteristic Descriptors Hill, Wiley, Nelson and Han (2004)
Learners like	Learning from other learners Open and honest dialogue
Learners do not like	Fellow classmates who do not keep up to date with work requirements Discussion/complaints about non course topics

Table 2.4 Course Requirements

Components of Student Satisfaction	Characteristic Descriptors Hill, Wiley, Nelson and Han (2004)
Learners want	Guidelines and course requirements from faculty To immediately apply knowledge learned to life situations
Learners do not like	URLs that do not work Purchasing books and software not fully utilized by the instructor

Two concluding observations from Hill, Wiley, Nelson and Han's (2004) research are relevant to the online learning environment and the pedagogy respectively. First in terms of the online learning environment when the survey results of students who perceived their own learning as 'very successful' were examined, it was found that they had high levels of online interaction with classmates. They also reported participating more in the online classes than in their traditional classroom experiences and had "positive interactions with the supporting Help Desk" (p. 438). Secondly, in terms of pedagogy simulation and an interactive learning environment require careful design because as Gredler notes (2004) considering theory developed from Vygotsky's ideas (1978), learners interacting in simulated and games environments "cannot develop advanced cognitive and self-regulatory capabilities unless they develop conscious awareness of their own thinking . . . [they] are searching for a solution but are not focusing on their thinking" (p. 579). She concluded that the desired learning outcome, the simulation and its 'associated context' must all be considered in the development of virtual learning environments.

2.4.2.2 Tools for the Interactive Learning Environment

Two electronic tools which were identified in the initial field study, interactive whiteboards (IWBs) and digital learning objects (DLOs), are considered for their impact on the online oncampus learning environment.

The first electronic tool, interactive whiteboards is the subject of research by Glover and Miller (2001) and Haldane (2007). Studies by both researchers examine classroom teaching practices associated with interactive whiteboards. They list the following advantages:

- IWBs save time in planning and preparation
- Lessons are readily accessed and visually complete at the beginning of the class
- Teachers share lessons and discuss pedagogical ideas more easily
- Classroom management is enhanced because concepts and skills can be easily demonstrated and replayed.

Haldane (2007) identifies a further advantage arguing that the combination of “verbal, visual and cognitive interaction with images and content displayed on a whiteboard” (p. 170) helps connect teachers and their pupils in the first few minutes of a lesson.

Miller and Glover (2010) explore the relationship between teaching theories and the use of interactive whiteboards in *A Model of Pedagogical Change for the Evaluation of Interactive Whiteboard Practice*. They conclude that teachers will have to be “more aware of the inherent value of interactivity at the heart of a changed pedagogy” (p. 118). Miller and Glover explain the envisaged change to pedagogy in terms of

Vygotsky’s (1978) theory of social constructivism which argues that effective learning occurs in those circumstances where there is an interaction between teacher and taught, or between students so that the problem is commonly understood and the solution collaboratively determined. (p. 119).

Coghill (2010) believes that the interactive whiteboard requires a specific pedagogy because “it is a tool that is largely mediated by the teacher (p. 168). He contrasts using an IWB with using a webcast, arguing that in the case of a webcast “technology is at the forefront of learning and the student is entirely dependent on how the technology frames the learning objectives” (p.168).

The second electronic tool, the digital learning object, is variously characterised as a small, modular, reusable, and constituent part of a larger learning activity. Wiley (2002) in *Connecting Learning Objects to Instructional Design Theory: A Definition, a Metaphor and a Taxonomy*, traces the development of digital learning objects from the design of modularised code in computer programming. He argues that the concept of a digital learning object is attractive to instructional designers because it offers reusability, adaptability and scalability. The Victorian Department of Education and Training (DET), in which this study is situated,

promotes the use of digital learning objects (DLOs) in the belief that “the flexible nature of [digital] learning objects gives teachers the opportunity to integrate ICT into all subject areas” (www.education.vic.gov.au/student/learning/teaching/resources 2006). In later research, *The Learning Objects Literature*, Wiley (2008) expresses disappointment with the rate at which digital learning objects are realising their potential. He declares that “a review of learning objects literature reveals a largely disconnected group of researchers united by an interest in reusing educational materials but little else” (p. 352). His findings suggest that curriculum designers have not succeeded in convincing teachers to make use of DLOs, largely because of difficulties associated with translating material from one learning environment to another. Wiley argues that successful utilisation of digital learning objects depends on their “adhering to specific structural and content standards to . . . provide the learner with exactly what she needs” (p. 352). He concludes that the assumption made by curriculum designers is that “humans will be involved in the process of localizing learning objects, and they [digital learning objects] rely on learners to engage in selecting what they want” (p. 352).

In teaching practice both tools, interactive whiteboards and digital learning objects, need teachers/learners to be involved in the selection of what is an appropriate component of a learning activity. This is supported in the findings of Mishra and Koehler (2006), who argue that effective use of any technology requires a complex interplay between content, pedagogy and technology. Their research found that teachers “with the right opportunities . . . grew in their capacity to understand the interactions between content, pedagogy and technology, suggesting that their TPACK [Technological Pedagogical Content Knowledge] had developed” (p.167).

2.4.2.3 Evaluations Internet Based Learning Environments

Findings from three studies: Collaborative Learning Environments conducted by Lockyer (2000); Assessing Students’ Perceptions of Synchronous Internet-based Learning Environments by Teh (2001) and Building a Profile of the Web Based Learner by Young (2006) presented at the Australian Association Research in Education (AARE) conference were selected because their research designs, analysis processes and findings were useful when developing the design for this study of information technology teacher’s perceptions of online oncampus instructional material. The research strategies followed in each of these studies are also of interest because they provide examples from both the Scientific and Constructivist paradigms and suggest, with respect to this study, where each is likely to be appropriate.

Study 1

An investigation of collaborative learning environments conducted by Lockyer (2000) examined health education delivered via the Internet. The report of findings was presented to the AARE conference by the designers of the course. They began their study believing that online learning would have advantages for collaborative learning, specifically that it promised:

- an increase in the variety of resources available
- the elimination of timetable constraints
- an increase in the range of group discussion and collaborative learning options
- increased exposure to diverse opinions and cultural perspectives.

Their strategy for moving from face-to-face to online learning began with the identification of material to be covered. This included gaining consensus and a shared understanding of what was to be achieved among “learning groups” (p. 2). The learning groups, comprising four to five students, were subsets of the larger tutorial groups. The criteria for the selection of participants are not recorded. This makes it difficult to determine if participants were self-selected and if this factor equated with greater skill or even confidence in the use of online resources than would be the case in a random selection of students. Notwithstanding, this is an examination of a pedagogical model within which an Internet based learning model was designed and a prototype developed, and is of interest. The idea of using learning groups to identify, develop and trial learning material appropriate to an online situation arose from the belief that “it was not possible to move directly from the face-to-face teaching and learning environment . . . without careful re-conceptualisation of how the pedagogy can be adapted . . .” (p. 2). The specific focus of this prototype was to develop processes for matching collaborative learning activities to appropriate technologies. The methods employed in this study are considered in the Methodology, Chapter 3.

Outcomes reported in Lockyer’s (2000) study indicated that while learners contributed fewer individual reports to groups, individual contributions showed far greater detail in the group discussions that were web or chat room based. The overall conclusion from his study was that design and pedagogy must be considered together and as such be re-evaluated. The Lockyer (2000) study presents an evaluation of numerous specific features of a collaborative online learning environment. The author argues that his study has two major findings for those organizing online education. First, skills in studentship and in group management need to be taught with particular regard to facilitating group decision making and secondly, that students need adequate access to lecturers.

Study 2

Teh's (2001) study *Assessing Students' Perceptions of Synchronous Internet-based Learning Environments* is an examination of the survey used to evaluate the relationship between a university computer-lab environment and student outcomes. It was presented as a report at the AARE 2001 conference. The course is described as a prototype comprising learning activities conducted in real-time [synchronous] and utilising "web-based mediated [tutor controlled] conferencing and telecomputing approaches" (p. 1). The course being evaluated operates under the jurisdiction of Singapore's Ministry of Education and within "the context of The Masterplan . . . a blueprint for the integration of information technology in education . . ." (p. 1).

In Teh's (2001) study, Moo's (1974) social scale, shown in Table 2.5, was used to provide a framework for the evaluation of the prototype. The survey was specifically evaluating the quality of the information, the external links recommended in the course notes and students' perceptions of learning activities. An interesting feature in his description of the course was the 'electronic reserve shelf'. Teh (2001) describes it as mirroring the function of a class folder on the reserve shelf of a traditional library, but with all the benefits of instantaneous electronic and remote access. There was also an important additional feature for those administering online courses called the "Web guide". It serves to "point students in the right direction . . . keep their research or online interaction on track . . . [and] prevent information overload" (p. 3). The evaluation instrument resulting from Teh's (2001) study is a survey. A selection of categories from that survey is shown in Table 2.5 below.

Table 2.5 Social scale -computer-lab environment - student outcomes

Scale Name Teh's (2001)	Description	Moo's Description
<i>Investigation</i>	Extent to which skills and processes of inquiry are used in problem solving and investigation.	Personal Development
<i>Innovation</i>	Extent to which the teacher plans new and varying activities and techniques and encourages students to think creatively.	System Maintenance [change dimensions]
<i>Resource availability</i>	Extent to which the computer hardware and software are adequate.	System Maintenance

The findings from Teh's (2001) study were analysed statistically within a scientific methodology. He stated in the conclusion that this survey has been 'cross-validated' as an instrument for "assessing student perceptions of internet based learning classroom environments" (p. 6). Teh (2001) concluded that it could be used with confidence. As in the previous two studies' focus on online learning they are of interest and considered in the Methodology, Chapter 3.

Study 3

Young (2006) presents interim findings from an ongoing study that aims to build a profile of the young web-based learner. This report is based on a case study of five participants using “observation, think-aloud protocols and post-activity interviews . . .” (p. 1). Young notes that in the years 2000 to 2003, “9-12 year olds in the USA recorded a growth in web-based exploring activities from 22% to 58%” (p. 1). Drawing on this trend and citing other statistics from similar research, Young contends that the web affects informal learning and this in turn will change formal learning. In the development of this argument, Young identified the web as a cognitive tool which will influence the individual learner . . . and “[in turn be] influenced by the individual’s actions . . .” (p. 4). Young’s study is conducted within a theoretical framework derived from three components of Cognitive Learning Theory: situated cognition; distributed cognition and activity theory. They are described by Young as follows:

First, *Situated Cognition*: the relationship between the students and their environment can be used to explain how learning occurs. In the theory of situated cognition the knowledge gained is “bound by . . . the materials and environments (i.e. tools, rituals and physical spaces . . .” (p. 6) making up the learners’ environment. Barab and Plucker (2002) concur with the conclusion that “effective learning occurs when it is situated in authentic activity Where authentic activity is the “ordinary practices of culture . . . ordinary people doing ordinary things” (p. 6).

Secondly, *Distributive Cognitive theory*: knowledge does not exist as an entity but evolves from the interaction between “tools, rules, values, artifacts” and the individuals inhabiting the learning environment. Through a sequence of culturally developed tools and activity the learner completes an action which “leads to new cognitions of what, how and why one needs to know” (p. 7). In this scenario, the web is a culturally developed tool and can be viewed as “forming part of the learner . . . rather than an external” (p. 7). The Internet is in a co-existent role with the learner.

Thirdly *Activity theory*: derives from the notion that learning is not a study of individual’s “learning in isolation, with only their minds to guide them [but rather] . . . individuals learning with a wide variety of tools to assist them to carry out goal oriented activities” (p. 8). It is socially organised practical activity and tool mediated activity that unites the mind with real world activities and events. Young’s (2006) research uses the “Activity Theory triangle” shown in Figure 2.1 to examine the relationship between the web and the individual learner.

Figure 2.1 Application of Activity Theory to Web-Based Learning
was removed to comply with copyright.

The image can be viewed on page 6 of Young's Study
Building a Profile of the Young Web-Based Learner
www.aare.edu.au/you04191.

Figure 2.1 Activity Theory Triangle

Young (2006) believes the web, is a tool which provides an opportunity to observe both interactive learning and the dynamic changes in the tool itself as cognition progresses. Young's research identifies activities, curriculum and "interpersonal relationships as elements of the learning environment" (p. 9). The study targets these elements specifically for examination believing they are reciprocally affected by the changes technology causes.

The strategies and methods of a naturalistic enquiry are used by Young (2006) to uncover themes. The preliminary findings from these processes are presented here as emergent categories. The five categories which emerged are: societal and cultural influences; situational boundaries; goals and outcomes; activities undertaken by individuals; the web as a cognitive tool and attributes of individual learners. Young notes as a concern, that these initial emergent categories "roughly related to the elements of interest raised through the integrated theoretical underpinnings of the study" (p. 11). Subsequent cycles of analysis eventually led to the individual learner being declared the *unit of analysis* and the following three robust emergent categories: participant citizen; tool mediated citizen and adaptive citizen.

In Young's (2006) study these three emergent categories lead to an examination of the learning environment comprising society, tools and individuals. They are listed as primary categories for the analysis process of her research. These primary categories and the secondary categories that emerged in subsequent analysis are shown in Table 2.6. The web based learner profiles for each is shown in Tables 2.7 to 2.9.

Table 2.6 Profile of the Young Web Based User

Participant Citizen Young (2006)	Tool-Mediated Citizen Young (2006)	Adaptive Citizen Young (2006)
Global Citizen	Technician	Efficient Worker
Commercial Citizen	Security Guard	Researcher
Communicative Citizen	Integrator	Director
Abiding Citizen	Design Analyst	

Table 2.7 Profile of the Young Web Based User: Descriptors of a Participant Citizen

Participant Citizen Young (2006)
<p>Global Citizen</p> <ul style="list-style-type: none"> Understanding of their community in Australia and Australia as part of the world Awareness that language variations occur across cultures Awareness of the impact of global distances on activities Awareness of the digital divide Understanding that different community groups throughout the world use the web for different purposes <p>Commercial Citizen</p> <ul style="list-style-type: none"> Understanding of economic values Consumerism: exposure to online advertising; <ul style="list-style-type: none"> knowledge of brand names and commercial organisations; online shopping activities <p>Communicative Citizen</p> <ul style="list-style-type: none"> Use of email Use of chat rooms and messenger services Understanding iconic representations <p>Abiding Citizen</p> <ul style="list-style-type: none"> Rules set by location boundaries Engaging in socially accepted practices

Table 2.8 Profile of the Young Web Based User: Descriptors of a Tool-Mediated Citizen

Tool-Mediated Citizen Young (2006)
<p>Technician</p> <ul style="list-style-type: none"> Competence (master v. apprentices) Efficient practices <p>Security Guard</p> <ul style="list-style-type: none"> Using logins and passwords Awareness of safety issues <p>Integrator</p> <ul style="list-style-type: none"> of various human senses of different online and offline activities of available hardware and software <p>Design Analyst</p> <ul style="list-style-type: none"> Analysis of various web site layouts Interpreting displays and graphical representations Understanding of use and limitation of the web Understanding of skills and knowledge required or facilitated through web usage

Table 2.9 Profile of the Young Web Based User: Descriptors of an Adaptive Citizen

Adaptive Citizen Young (2006)	
Efficient Worker	
Scanning for key words	
Skimming texts	
Evaluating material	
Automaticity in response	
Researcher	
Search for information	
Navigate through sites	
Comparison of tools for purpose	
Director	
Flexibility	
Persistence	
Focus	
Personal preferences	
Self regulation/ Self Monitoring	

Young (2006) illustrates the difficulty of making judgments about a ‘learner’s success’ in her study by comparing the notion of competence in the past and present using the example of the Adaptive Citizen: Efficient Worker (Table 2.9). Competence in the past was “generally claimed when the learner demonstrated both accuracy and fluency with a given task or situation [in a given time]. . . ” (p. 16). In web based learning, Young believes the concept of speed is different and can be viewed in numerous forms including: scanning for key words; skimming for context; interpreting graphics; evaluating material towards goals and automatically responding to tool (Internet) related functions. Young (2006) concludes from her study that participants’ speed has evolved in line with their “personal engagement” with the web and that “if children are automatically responding rapidly in the web based learning environment . . . we must try to understand how this technique has changed learning and what . . . educators need to do to facilitate growth and maximise experiences” (p. 17).

This section has outlined the findings from a variety of research reports of Internet based learning. The reports examined and elaborated the previously discussed pedagogies in the context of e-learning environments. They also provided a variety of strategies and instruments for evaluating the effectiveness of online oncampus courses.

2.5 Resources

The resources for learning in an online environment considered in this section are those categorised under the two broad headings instructional material and the teacher.

2.5.1 Instructional Material

The theories reviewed here relate to the design of instructional material in the context of an online and oncampus environment. In their introduction to *Missing the Meaning*, Peacock and Cleghorn (2004) see the objective for those designing instructional texts as matching texts to the preconceptions, expectations and inclinations of learners and teachers. In a close examination of science texts their first observation is that since the 1980s “there has been an emerging globalisation in the way school texts are commissioned, constructed and marketed” (p. 182). This has resulted in millions of students across the world receiving instruction in English, which for many of them is a second language. Peacock and Cleghorn see a number of implications for those designing instructional material within Constructivist pedagogy. At the conceptual level for example, the objective becomes enriching learning rather than “helping learners re-organise their knowledge and correct misconceptions . . .” (p. 182). They identify general guidelines for those designing and creating instructional material for a global environment. A summary of their recommendations includes:

1. The cultural difference among learners needs to be acknowledged in the prescribed curriculum, the pedagogy and the perceptions of teachers.
2. The function of text in teaching has to become clarifying teachers’ and learners’ notions of addressing training needs in the development and use of text.
3. Techniques for improving text quality need to be improved to facilitate more effective learning.
4. The potential of electronic media to provide new forms of learner-text interaction needs to be explored.

These are cross referenced with findings in Ally (2004) where the criteria for design of instructional material is categorised according to pedagogical underpinnings. The terminology used provides an enriched basis for comparison with findings from other online oncampus environments. These are considered further in the Chapter 3, Methodology.

Peacock and Cleghorn (2004) present a close examination of the design of instructional material in *Teaching the Page*. First, their study examines in detail the traditional Teacher-Learner-Text relationship by considering these three dimensions in the pairs set out in Table 2.10 below:

Table 2.10 Selected Components of the Teacher-Learner-Text Relationships

Relationships Peacock and Cleghorn (2004)	Dimensions
Teacher-Learner	teachers' attitudes . . . in culturally diverse settings;
Teacher- Text	the role the text is perceived to play . . .
Learner- Text.	the potential for text to affect conceptual change in learners

Secondly, Walpole and Smolkin (2004) report on a study conducted under naturalistic as well as experimental conditions. Their report described an attempt “to integrate theoretical perspectives from sociolinguistics, pedagogy and psychology using both qualitative and quantitative methods of data collection and analysis as appropriate” (p. 183). The Walpole and Smolkin (2004) study compared examples of traditional texts dividing the instructional material into two categories: ‘considerate’ and ‘inconsiderate’. The features listed that make texts considerate include: “strong introductions; headings and sub-headings and tables outlining the text’s structure” (p. 198). In a considerate text for example, any information that disrupts the global coherence is moved to less important positions in the text and the use of pronouns and conjunctions is carefully monitored to ensure they enhance understanding. The findings from their research showed clear improvements in children’s comprehension for those who read what were deemed considerate texts.

The study of Walpole and Smolkin (2004) places comprehension within the Cognitive pedagogy and following ideas credited to RAND (Rand Reading Study Group, 2002) they describe it as the active process of extracting meaning and integrating prior knowledge and text content. In detail this process involves the reader initially linking words into phrases and processing the text to maintain local coherence. The reader then “restructures the basic information hierarchically, drawing on his or her store of prior knowledge” (p. 199). The authors believe this is the actual cognitive process which leads to overall understanding of the text. From their analysis, Walpole and Smolkin (2004) conclude that these skills can be developed in children, when teachers “analyse and mediate between the specific demands of the text and the specific skills of the readers” (p. 199). This again, is reflected in the list of appropriate features for the design of online instructional material found in Ally (2004).

In a third report by Peacock and Cleghorn (2004) the text in a fantasy narrative presented in zig-zag fashion is compared to information presented in straight forward structure. The second format is described as a traditional structure and is characterised as easy to use with straight forward navigation. It is typical of the format found in trade texts. They conclude trade books may be especially effective choices for independent learning because students get

a chance to build and practise these cognitive strategies before they are confronted with less considerate texts.

In a general observation of learning from reading books, Walpole and Smolkin (2004) state that learners' prior experiences have taught readers to look for large blocks of running text where they know "the meat of meaning is located . . . [and that readers] . . . make little use of adjunct text aids such as titles, preview questions and sometimes even pictures" (p. 207). They also believe that for learning activities relying on visual literacy, the reader must be alerted to titles, questions and images to ensure they are used in the learning process. This concurs with the International Visual Literacy Association's (IVLA, 1989) early definition of visual literacy as "the learned ability to interpret visual messages accurately and to create such messages, translate visual images into verbal language and vice versa" (p. 223).

Walpole and Smolkin (2004) believe the process of constructing knowledge includes teachers asking questions about the construction of the pages and layout of drawings as well as the construction of meaning from content. As an example, the teacher asking "Why has the author chosen to label illustrations in this way?" would be used to start a metacognitive discussion that would teach students to make purposeful text processing decisions . . ." (p. 208). This is consistent with the notion of learners developing a conscious awareness of their own thinking.

Traditional characteristics associated with 'considerate' instructional material are outlined in Barba (2004) and include: text organisation; cohesion; explication; conceptual density; meta discourse; readability; page layout and design; alignment; proximity; repetition and contrast. Describing examples of science web sites as often "packed with inaccurate, poorly organized and uninteresting information" (p. 239), Barba (2004) outlines the processes by which 'friendly web-pages' are identified, designed and developed. When additional features appropriate for an online environment are considered, Barba (2004) lists only two: links and navigational devices.

Taken together, the findings of Barba (2004), Walpole and Smolkin (2004) and Peacock and Cleghorn (2004) suggest visual literacy with its notion of considerate or friendly text has many well developed principles the designers of online instructional material need to consider. Their suggestion that learning includes teaching students to be consciously aware of computer navigational features and links fits well with teaching strategies developed from Gardener's (1983) multiple intelligences.

The findings from research by Swann (2013) and Alzaghoul (2012) in the field of e-learning were published during the final stages of the analysis processes of this study. Swann's study examined "learner responses following completion of 393 courses developed by a commercial elearning provider" (p. 61). His research focused on selected online courses which utilized combinations of media (audio, text and images). It aimed to "determine how learner engagement is influenced by two cognitive learning principles: "John Sweller's split-attention principle and Richard Mayer's multiple representation principle" (p. 61). Swann also draws on Baddely's (2000) research to make comparisons between the various ways in which learning is influenced by text, audio and images. He notes that onscreen text is not automatically accessed by the learner and concludes, "Conscious effort is required on the part of the learner to read . . . In short, words go better through the ears and images go better through the eyes" (p. 62).

Alzaghoul (2012) in a small study examined pedagogy as it is applied in the field of e-learning. He draws on Koohang, Riley and Smith (2009) to define e-learning as "the delivery of education including the activities of instruction, teaching, learning and assessment through various electronic media" (p. 27). Alzaghoul argues "that a shift to pedagogy-based courses can be observed within the field of e-learning" (p. 27). He concludes that Behaviourist, Cognitive and Constructivist learning theories are the most commonly known and that knowledge of these and other learning theories is important because it helps others who are developing e-learning to make informed and "easy decision[s]" (p. 30).

The strategy for examining the most up to date theory and practice in these rapidly evolving fields is discussed in the Methodology, Chapter 3 Section 3.6.7.1.

2.5.2 The Role of the Teacher

Cox (2003) opens a Report on Focus Group Discussions in *The Role of the Teacher* with the following general observations about the Internet and teachers. In an online environment teachers are distributed in time and space. The communication provided by networking increases the "connectedness of individuals [and] supports the formation of teams of people who contribute to a particular student's learning" (p. 203). Information Communication Technology (ICT) has the potential to provide infrastructure to support the Behaviourist, Cognitive or Constructivist pedagogies. Considering each of these pedagogies, Cox examines three likely scenarios for the teacher to student interaction in an online environment: face-to-face; hybrid and distributed teacher.

Face-to-Face Learning

In the face-to-face scenario, learning takes place in person. Instruction is provided by teams of professionals in a building with flexible spaces. The students and teachers belong to a community committed to life long learning. In the ideal, the boundary between learners and instructors is flexible. In this environment teachers have knowledge of learning theories and the associated learning processes along with digital connection to other professionals. As with all three scenarios, Cox (2003) envisages learners and instructors having open access to “an electronic learning environment . . . and knowledge databases” (p. 204).

Hybrid Learning

In Cox’s (2003), hybrid scenario, learning is both face-to-face and at a distance. Instruction takes place in a building with flexible space and with electronic facilities that extend the capacity to organise flexible time. Teams of teachers create a learning space and aim to empower students as independent learners, ultimately with the ability to adapt. Teachers share “learning strategies, materials, techniques, resources . . . with colleagues both local and distant” (p. 205). Cox presents the hybrid learning environment as one where teachers act as “the Hub” at the centre of complex interactions between students, culture, language, other teachers, media experts, and educational authorities. In Cox’s view of hybrid learning, teachers cater to the diversities of students’ needs by adapting teaching strategies to suit the students’ backgrounds.

Distributed Learning

In the distributed learning scenario students are enrolled in non-attendance schools. All contact is online. Cox (2003) imagines the roles of professionals supporting learners in the distributed learning environment. For example, she gives the name Sika to the person whose job it is to “maintain close network contact with 100 year 10 students studying a full curriculum in a cluster of four non-attendance schools” (p. 205). Sika does not actually teach these students but rather she organises each individual’s learning programs by using a range of “pedagogical software agents” (p. 205). In this scenario the curriculum is managed by curriculum agents and includes use of the diverse range of populist Internet facilities such as a “virtual weekly Karaoke Show and Tell” (p. 205).

In all three scenarios there are places for the Behaviourist and Cognitive learning theories and arguably within the Radical Constructivist pedagogy of von Glasersfeld (1990) in which cognitive activity is not separate from context.

Godinet (2004) similarly imagines teachers requiring expertise in a variety of pedagogies. In her report with the provocative title *Distance Actors on a Digital Campus, Sharing and Crumbling Pedagogical Responsibility* she described teachers and students as “networkers on a virtual campus” She identified competencies that teachers will have to acquire when they collaborate interactively on “a web-based learning platform” (p. 229). Godinet predicts that the level of expertise required to acquire these competencies in a technical and socially complex environment will be too great for individual teachers. She believes the tasks will be performed by teams of experts with questions of responsibility for the individual learner and pedagogy left for debate. In this scenario the teacher’s current role disappears and is replaced by teachers in ‘partnerships of experts’.

Godinet (2004) includes a report of the digital campus FORMation Resources en Sciences de Education (FORSE, 2004) that was set up in France to serve the needs of distance education tertiary students along with teachers and trainers who want “to certify their professional experience” (p. 230). The FORSE online community consists of learners, teachers, tutors, coordinators, evaluators, administrators and designers. In a telling observation that exemplifies the likely environment teachers will face, Godinet’s study describes multimedia resources written by “European teams, . . . experts on each topic”(p. 231), who sell the learning material to the institution and then take no interest or responsibility in how it is delivered. She notes that the online tutors received no traditional training for the job but relied on virtual workshops, email forums and various other collaborative tools, which she assumed to be mostly electronic. Students in the FORSE online community are required to spend a designated amount of time on campus. They receive a CD-ROM and printed material and are provided with on-line resources including workspaces. This digital campus is a work in progress and will be examined periodically as this research unfolds.

Godinet’s (2004) concept of the teacher of the future concurs with many of the theoretical predictions and observations presented in this chapter. In summary, teachers in the online environment will combine their collective skills in association with groups of experts in various fields of knowledge to produce/share multimedia resources, imagine and facilitate new teaching methods, liaise with tutors to review resources, experiment with new ways of assessment and certification, define new curricula, run virtual workshops and newsgroups and tutor students. In Godinet’ model, managing and marketing are included in this list, but in other papers this is contested. Those authors who promote the concept of teachers ‘marketing and managing’ believe that management of student records and finance along with interpretation and elaboration of curriculum documents can be automated. Some also suggest that dialogue with human tutors need only be available when the learning process requires it.

Godinet (2004) questions the notion of a teacher centred e-learning environment. “Are we convinced that the teacher is the ‘hub’ that structures important links, elaborates meaningful tracks and maps between knowledge, the learner and society?” She does not answer the question instead she offers the possibilities of a digital campus where students can “learn inside and outside, face-to-face, alone or guided” (p. 233).

2.6 Conclusion

Behaviourist, Cognitive and Constructivist learning theories have been examined in the context of an e-learning environment in this review of literature. Amongst the many commentators each learning theory has found a place in scenarios deemed appropriate for an e-learning environment. Concepts derived from Behaviourist and Cognitive learning theories for example, were found in much of the theory underpinning the design of educational material for online use. Constructivist learning theory is associated more frequently with the larger scale organisational requirements, with for example, models of infrastructure employed to utilize Information and Communication Technology (ICT) in the collaborative learning experience.

I note the belief shared by many education researchers, curriculum development experts, teacher educators and teachers that in the e-learning environment the teacher/instructor role will be that of facilitator at the hub of a huge variety of resources. This supports the notion implicit in much of the literature that an orderly restructuring of familiar teaching practices will follow the wide spread uptake of the Internet in the same way that many policy makers assumed reforms rather than revolution would automatically follow the introduction of computers and educational software. Some commentators suggest that in the fully automated ICT environment the individual learner will become the basic unit of analysis and are not clear about the role teachers will play. In many scenarios the roles of learners and teachers continually interchange as the notion of lifelong learning in a knowledge society comes into being.

In light of this study’s focus on information technology teachers’ perceptions of online oncampus learning materials some of the studies referred to in this Literature Review have the following limitations:

- Keller and Suzuki’s research was completed in 1988.
- Lockyer’s research dealt with health education and was completed in 2000.

- Teh's research dealt with the relationship between a university computer-lab environment and student outcomes. It was completed in 2001.
- Young's research dealt with students not teachers.

I believe that exploring VCE information technology teachers' perceptions of instructional material for online and oncampus environments will add to existing theory in the field. The following chapter Methodology outlines the design, methodology and data gathering techniques used in this study to investigate the research question posed.

Chapter 3 Methodology

3.1 Introduction

This chapter presents the methodology chosen to address the initial research question: Are the major learning theories of the late twentieth century (Behaviourist, Cognitive and Constructivist) evident in the online learning materials of VCE online oncampus learning environments? This study investigated online oncampus instructional material and techniques used to teach students studying information technology as part of the Year 12 Victorian Certificate of Education (VCE) in Victoria Australia in the years 2006 to 2010.

The information technology teachers participating in this study were working in an online environment face-to-face with students who are studying in classrooms at secondary colleges in the traditional oncampus fashion. The context for the study is one of secondary educational institutions operating in the first decades of an information age. The learning material to be examined is produced for students studying Information Technology Applications and Software Development as part of the Victorian Certificate of Education (VCE). The VCE is accredited by the Victorian Curriculum Assessment Authority (VCAA) for the purpose of providing Year 12 students with a study score for each subject. The *VCE Assessment Handbook Information Technology 2007-2010* VCAA (2006b) explains that a student's overall achievement in a subject is reported as a study score and "is used by the Victorian Tertiary Admissions Centre (VTAC) for the calculation of the student's Equivalent National Tertiary Entrance Rank (ENTER)" (p. 2). The ENTER score (which has changed to ATAR, Australian Tertiary Admissions Rank, and at the state level VICTER, Victorian Tertiary Entrance Requirement) is used to determine entry to local university places.

This section describes the context for the research question and sets out the reasons for employing a constructivist paradigm identified in Denzin and Lincoln (2003) and the case study methodology and qualitative methods within that paradigm. Studying phenomena in the natural world within a constructivist paradigm is described in Denzin and Lincoln (2003) as "connecting the researcher to specific sites, persons, groups, institutions . . . and documents and archives" (p. 36). Guba and Lincoln (1985) in their earlier writings refer to constructed realities where objects of study "cannot be separated from the worlds in which they are experienced" (p. 37).

The theory summarized by Denzin and Lincoln (2003) underpins the strategies, procedures and techniques used to conduct this investigation. Their paradigm or world view assumes

“multiple realities . . . [where] knower and respondent co-create understandings . . .” (p. 35). This constructivist paradigm, is endorsed by Patton (2002) as appropriate where the researcher “sets out to understand and document the day-to-day realities of participants . . . accepting the complexity of a changing program reality” (p. 42) and is therefore deemed appropriate for an examination of the instructional material and techniques identified in the research question of the current study.

A methodology described as a collective case study by Stake (2003) was used to underpin strategies for collecting, coding and interpreting qualitative data from eight cases. At the start of his discussion of the case study methodology Stake defines a case as “a specific, unique, bounded system” (p. 136). In this study the criteria for selecting each of the eight cases are specified in detail. Each case was unique in that each teacher was in a different school setting teaching students from a variety of socio-economic groups and using computer networking equipment that has evolved and been upgraded according to local needs. The cases are bounded by the IT teachers, the VCE, secondary schools and the technical capability of the ICT hardware and software at the time the interviews were conducted. The uniqueness of each case was established by extensive descriptions of the school’s community, history, buildings and choice of network.

The interviews, observations and collection of artifacts were conducted in each school, the natural setting, which Denzin and Lincoln (2003) deem appropriate for a study of this type because “it situates the researcher in the empirical world” (p. 3). They place the actions associated with the research methodology into the two broad headings of inquiry and interpretation. Denzin and Lincoln establish the notion of inquiry, by tracing its development from the formalized study of groups stating that it was originally “established for the study of group life” and then developed over the twentieth century to be later “employed in . . . [the study of] education” (p. 1). The second heading interpretation, is defined by Denzin and Lincoln as “making sense of one’s findings” (p. 37). This inquiry is properly conducted in the school environment for Guba and Lincoln (1985) where the process of making sense is influenced by the natural setting because “any observations that might be made are inevitably and largely context dependent” (p. 37).

The choice of a methodology within the constructivist paradigm has consequences for the role of the researcher, in particular the acceptance of the notion of constructed realities and its consequences for the researcher interpreting observations. The researcher, acting the part of ‘human as instrument’ Patton (2002), utilizes all of the observational skills and intuitive knowledge he/she brings to the study as a human being. The researcher in this study is an

experienced information technology teacher who fits the profile of the teachers chosen as participants for interview in this study. The tacit knowledge of the researcher is viewed as an attribute to be utilized.

This case study methodology is further refined . . . and described in Stake (2003) as an “instrumental case study extended to several cases” (p. 138). The instrumental case study Stake characterizes as one where the individual case is looked at in depth but only so far as it helps the researcher to explore the research question. “When the purpose of the case study is to go beyond the case, we call it an instrumental case study.” (p. 8). This extends the notion of a research question so that it is not “dealing only with the binding concept . . . but rather focusing and using it as a conceptual infrastructure” (p. 8).

The cases to be studied were purposively selected as those most likely to produce rich data and provide the researcher with a capacity for what Patton (2002) refers to as ‘thick description’. Each case is then an ‘instrument’ in the study of the perceptions of the teachers creating learning material for an online oncampus environment. In this strategy data is collected for each case, because Stake contends “understanding them will lead to a better understanding . . . [of] a still larger collection of cases” (p. 138).

It was important then that the teachers invited to be interviewed were able to provide the study with rich data. Refer Appendix E, Standard Open Ended Questions (p. 2190). The eight information technology teachers interviewed were for this reason ‘purposively selected’ Patton (2002) because the researcher believes by following Patton, most could be learned from practising IT teachers. In this situation the researcher and the object of study are in what Guba and Lincoln (1985) originally characterized as “a relationship where they interact to influence each other” (p. 38).

Each of the eight interviewees teaches VCE information technology at a secondary college in Victoria, Australia. Their experience in the role of information technology teacher ranges from 11 to 17 years and they all produce learning materials for their students that are used on campus, in class and online. These eight teachers all subscribe to an online educational mailing list that provides a forum for the discussion of a full range of issues related to teaching IT, and to this study. The interviewees were selected because their comments and instructional material offer what Patton (2002) describes as “useful manifestations of the phenomenon of interest” (p. 40). The online learning material created by participants was

collected and examined in an analysis of documents following processes identified by Patton (2002) and described as one from which “qualitative findings grow” (p. 3).

These qualitative methods set out in Patton (2002) were used to “study selected issues in depth and detail . . . without being constrained by predetermined categories” (p. 13). The resulting qualitative findings “which grew from in-depth interviews, direct observations and written documents” (p. 4) are appropriate to this study where the teachers and creators of the learning material are working in the real world. Refer to Appendix E, Standard Open Ended Questions (p. 219). The researcher accepts Minichiello’s (2008) proposition that in-depth interviews are appropriate where “people’s knowledge, interpretations and perceptions of their experiences and interactions are the properties of the social reality which . . . research questions are designed to examine” (p. 68).

The strategies discussed above are important in establishing what Guba and Lincoln (1997) called ‘trustworthiness’. The components of this they list as: credibility; transferability; dependability and confirmability. These are discussed and illustrated in the following section in the context of a case study methodology.

3.2 Methodology

This section outlines the methodological design for the research and the strategies to be followed within that design. The methodological procedures for conducting an instrumental collective case study associated with the constructivist paradigm and the criteria for presenting findings based on established coding procedures are set out below.

3.2.1 Case Study

This research follows a case study methodology as set out in Stake (2003) and Patton (2002). This is a collective case study of eight purposively selected teachers who design and use learning material for their VCE information technology classes in the first decade of the 21st Century. They all conduct their VCE classes both online and on campus. The case study methodology was chosen for this investigation because it employs strategies and techniques for studying the perceptions of participants working in a defined environment.

This case study methodology provides for the examination of interview and artifact data in the belief that interdependencies and patterns may emerge from a systematic and disciplined search of both sets of data. The decision to study eight cases collectively is supported by Stake (2003) who states that studying the phenomenon of interest in a number of cases within a bounded environment helps us to understand the environment, system or context for each

individual case. In earlier work Stake (1994) states that when we study one case “we cannot understand this case without knowing about others” (p.237). This is also consistent with the strategy he recommends where there is an initial search across all the cases for what is intuitively “common . . . and what is particular to one” (p. 237). Stake (2003) stresses the need for the researcher to “present the case in sufficient detail so that the reader can make good comparisons” (p. 148).

The eight cases were chosen because they were bounded by four constraining requirements: the VCE curriculum; the interviewees who were all experienced IT teachers; the online instructional material used in secondary schools and the capacity of the Information Communication Technology (ICT) available at the time. The VCE learning outcomes are set out in the *VCE Information Technology 2007-2010 VCAA* (2006a). IT teachers must have qualifications mandated by the Victorian Institute of Teachers (VIT). Secondary schooling describes schools catering for students studying the Year 7 to 12 curricula. ICT in this study is the capacity of the current communication network hardware and software designated as able to deliver learning material in the first decade of the 21st Century.

Each individual case was studied to provide insight into the design and use of learning material for an online environment and is therefore what Stake (2003) terms the *Instrumental* case study, where each case is “looked at in depth . . . because this helps us pursue the external interest” (p. 137). The decision to use instrumental case studies across a collective of eight cases also concurs with an approach identified in a summary by Flick (2006) as one where “sampling decisions aim at that material that promises the greatest insights” (p. 126).

In summary this research followed an instrumental collective case study methodology using qualitative methods to co-construct meaning with the participants. The research methodology set out in Denzin and Lincoln (2003) is derived from the early Lincoln and Guba (1985) theoretical position where constructivist inquiry requires a human as instrument, “fully adapted . . . to the indeterminate situation that will be encountered” and who employs “interviews, observations, document analysis, unobtrusive clues and the like” (p.187). The set of personal and professional values the human researcher brings to constructivist inquiry influences among other things, the choice of problem, the boundaries for investigation and the point of focus or emphasis at any point during the study. This study then relies on well documented strategies to provide confidence in the findings. Denzin and Lincoln (2003) believe “applying the suggestions of Guba and Lincoln (1985) and others” (p. 68), helps make transparent the inherent subjectivity of employing the “human as instrument” to examine phenomena in the real world. The elements required to establish confidence in this study are

credibility, transferability, dependability and confirmability. The strategies associated with these elements included in the planning of this study are presented in the following section.

3.2.2 Credibility

In this collective case study credibility was established by:

- Prolonged engagement

Contact with each interviewee was established by telephone and email, and a schedule for data collection discussed and arranged. Over a period of four years the interviewees were each asked to clarify or comment on various features of interest observed in associated curriculum documents and websites containing instructional material. Interviewees were also asked to read the transcript of interview and make any alterations they wished.

- Explaining procedures for data collection

Data were collected from each subject in a recorded interview. A set of five standard open ended questions were used to provide a common structure for each interview and make it possible to compare the data collected. Refer to Appendix E, Standard Open Ended Questions (p. 219). At the finish of each interview the subject was asked for documents supporting his/her descriptions if these were not offered.

During the four years 2006 to 2010 each participant was given the opportunity to view the transcript of interview and make further comment if they wished. Three interviewees Alan, Margot and Louise participated in informal face-to-face conversations as issues in the coding process arose. Six of the participants Catherine, Alan, Margot, Bill, Daniel and Louise provided and/or discussed online learning activities on the Information Technology Teachers' email list. These documents and learning activities together with the participants' comments during informal conversations and email communications were collected and used in the analysis procedure. Refer to Appendix I, Table 5.8 Cross-case Summary of Artifacts and Observations (p. 225).

- Making the data collected available and ready for re-analysis

The interview data were collected as voice recordings and converted to written transcripts. The voice CD and transcript file for each subject were labelled using the code shown in Table 3.1 below and stored in a secure location. They were made available for member checking and peer review and auditing (Appendix D) as required.

Table 3.1 Coding for Voice Recording, Transcripts and Online Instructional Artifacts

Subject	Interview (Time min-sec)	Transcript (line no.)	Artefact (Item no.)	Interview Date
A	AInt-00-00	ATran-0000	AArt-00	11/12/2006
B	BInt-00-00	BTran-0000	BArt-00	27/02/2008
C	CInt-00-00	CTran-0000	CArt-00	02/08/2007
W	WInt-00-00	WTran-0000	WArt-00	13/08/2008
G	GInt-00-00	GTran-0000	GArt-00	22/10/2008
D	DInt-00-00	DTran-0000	DArt-00	16/03/2009
L	LInt-00-00	LTran-0000	LArt-00	17/09/2009
R	RInt-00-00	RTran-0000	RArt-00	09/12/2009

- Noting and reporting negative instances

During the analysis particular interest was paid to noting and reporting negative instances in the search for common themes across the cases. Stake (2006) contends that some of the important findings from the cases “will be context-bound”(p. 41) and that noting the commonality and differences across cases helps to tease out complex meanings of the group of cases.

- Acknowledging biases

The bias of the researcher is a facet of the tacit knowledge utilised and is acknowledged to alert those reading the findings to the possibility of inadvertent emphasis in one direction. Noting bias also served to remind the researcher that the practice of regular peer debriefing during the analysis helped identify emergent categories and links that might have been otherwise missed. I was consciously aware of my IT experience and therefore the potential for bias. I recorded in research journals, the thoughts and readings which informed the decisions I made during coding and analysis of the data. I constantly reflected on, and discussed with my peers, the categories I had chosen to describe the data and my interpretations of patterns which I subsequently inferred.

That personal bias is an issue of concern in a constructivist inquiry is noted by Strauss and Corbin (1990). They also observe that an informed inquirer has a richer knowledge base to draw on, but can miss things “that have become routine or obvious” (p. 42). Scheduling peer

reviews throughout the course of the research provided procedures that detected the professional and personal bias of the researcher.

- Documenting fieldwork and analysis

A series of notebooks were kept to record the observations during fieldwork and any associated thoughts that would prove useful in directing the strategy for collecting artifacts and preparing new questions. The process of identifying ‘the right question’ to clarify some aspect of the design and use of learning material in an online environment was central to understanding this phenomenon.

- Clarification of the relationship between assertion and evidence

The evidence on which assertions depended followed a labelling regime established that made a clear distinction between primary and secondary evidence. Primary evidence consisted of voice recordings, transcripts of interview, documents collected from the interviewee and online instructional material authored by the interviewee. Each was labelled according to the code shown in Table 3.1 above.

Secondary evidence comprised emergent themes arising from the data collected, theoretical constructs derived from theory and interpretations and descriptions formed by the researcher. Credibility for secondary sources was established by:

- Journals

Journals were used to keep track of activities during the different stages of the study and record peer debriefings and memoing. Procedures for auditing the collected data were used to check the quality of data and the credibility of the findings. Denzin and Lincoln’s (2003) concept of triangulation used in this study “recognises the many facets of any given approach to the social world as a fact of life” (p. 67). It involves data triangulation “the collection of data from different sources” (p. 67). Keeping a journal to reflect on the interpretation of data from different perspectives also allowed me to constantly re-visit previous view points. The research journal, was used to document peer reviews. It was used to record my daily thoughts and assumptions throughout the study. It contained summaries of feedback and reasons for actions which arise from feedback.

In this design the researcher was a participant. The procedures described here are grounded and consistent with the critical theory described by Strauss and Corbin (1990). The descriptions and interpretations derived from each interview were constructed by the

researcher for the individual case reports. These processes for construction included: a definition of terms; a description of the subject; codification of data by the researcher; collation of results; the interpretation and finally the report of findings by the researcher. The eight VCE IT teachers participated in in-depth interviews, and follow-up conversations. They provided annotations to transcripts or comments by email or by telephone. The interviewees within this design are seen as active informers and members of a community of practice. The coding and searching for emergent themes in the data from individual cases and across the multiple cases was carried out by the researcher.

In summary, credibility was established by following procedures that ensured the researcher's interpretations were consistent with the respondents' perceptions. A schedule of prolonged engagement minimized the possibility of misinterpretation. A process of peer debriefings was used to test interpretations and the respondents' annotations to transcripts were kept along with a record of the peer debriefing processes to validate the procedures in a final audit. Evidence was presented from taped interviews, emails, documents and online material collected from the working environment of the participants, and archived for future reference. These procedures are described in Denzin and Lincoln (2000) as "plausible and credible" (p. 881). Data and interpretations have been cross-checked/peer reviewed at various stages of the research by others who were identified in the initial field study.

3.2.3 Transferability

The second criterion, transferability, was established by following a case study methodology which generated rich data about the context. The strategy outlined in Patton (2002) provided rich detailed data which led to what is termed "thick description" (p. 316). Patton (2002) notes that 'thick description' precedes and is separate from the interpretation which is in turn separate from judgments. The findings of the research will be transferable to a second setting where judgments reliant on 'thick description' can be made about similarities between the settings. Purposive sampling ensured interviewees were selected who were most likely to provide the rich source of data required. These processes underpinned transferability.

3.2.4 Dependability

The third criterion, the dependability of the research, was established by following a strategy outlined in Patton (2002) as one that allowed the design to "emerge flexibly as new understandings open up new paths of inquiry" (p. 331). All procedures were documented and any changes to the design clearly noted and accompanied by references to the associated theory. The field notes and the thoughts and experiences that might affect the researcher's

perceptions, and as a consequence influence the strategic decisions, were kept in a research journal. Again these were archived so that the processes and findings could be examined.

3.2.5 Confirmability

The fourth standard, confirmability, was established by collecting data used to confirm the interpretations, strategic decisions and findings from multiple sources. This mimics the practice of ‘triangulation’ used in surveying to calculate an unknown distance from three known points of reference. In this study the points of reference are: a research journal; a collection of artifacts; and two processes known as ‘member checking’ and ‘peer debriefing’. Member checking procedures include emails, telephone conversations with the interviewees, their annotations to transcripts of interviews and to responses to questions proposed by the researcher. These notes and records were used to check the interpretations and inferences made by the researcher during the transcription, coding and analysis processes. Peer debriefing procedures were used to help the researcher identify the influence of personal bias during the research. These procedures included regular discussion with peers, re-checking coding and interpretations and an audit of the references to data collected during the study. These were archived to provide an audit trail consisting of raw data, analysis, process notes, instrument development information and notes relating to intentions.

3.2.6 Observing Documents

Data in the form of online learning material were also collected from the eight teachers interviewed to see how their perceptions of the learning material they had created were evidenced in that material. These were examined following the processes described in the next section, Methods.

3.3 Methods

This section presents the strategies for the collection and analysis of data within this case study methodology. These included:

- In-depth interviews with Information Technology teachers who were the creators of online learning material used in their VCE classes within the state of Victoria for accredited courses.
- Observation and analysis of the online learning material produced by the interviewees. In five instances this involved logging into the VCE section of the school’s network and examining sequences of lessons and following links. In one instance lessons were demonstrated by the interviewee using intelligent white board technology. In two instances

the interviewees provided CD ROM onto which their online instructional material had been downloaded.

- Electronic copies of the online instructional material referred to by interviewees were saved as files on CD-ROMs along with printed copies of the screens taken from those files. The printouts of screens were examined in conjunction with the appropriate interview and annotated for features of interest. Refer to Appendix I, Table 5.8 Cross-case Summary of Artifacts and Observations (p. 225).
- Notes were kept of ideas developed from the ongoing review of literature in the fields of ‘instructional design’ and ‘online learning’.
- Notes were kept of theories and findings recovered from ongoing searches of existing databases for studies conducted into online learning for VCE students in Victoria.

A number of writers cited in the Review of Literature Chapter 2, provided the context for the initial stages of this study. These are noted in the Review of Literature which examines electronic communication and the Internet in terms of their potential to provide infrastructure to support the Behaviourist, Cognitive or Constructivist pedagogies. Throughout the study literature also provided theories described in terms of the impact of electronic communication and the Internet on society in general and on teaching and learning in particular. Cox (2003) for example, discusses *The Role of the Teacher* and observes that in an online environment teachers are distributed in time and space and their use of networked communication increases the “connectedness of individuals [and] supports the formation of teams of people who contribute to a particular student’s learning” (p. 203). These findings and others provided descriptors used to categorize data during the coding process.

3.3.1 Selecting Interviewees

To commence the research, permission to approach and interview eight teachers who are the authors of online learning material for the VCE Information Technology classes they taught was sought from RMIT Human Research Ethics Sub-Committee (HRESC) (Appendix A). When HRESC approval was granted, a letter outlining the study and seeking approval to proceed was sent to the Department of Education and Training Victoria (DET) now the Department of Education and early Childhood Development (DEECD). The procedure for the purposive selection of participants commenced when permission was received from DEECD. A list of VCE Information Technology teachers who produced online learning

material for oncampus use with their classes was prepared. Those who presented at conferences and provided online material for others teachers to trial, were deemed most likely to supply the rich data required. They were approached to be candidates for in-depth interviews. Those who agreed to be interviewed were sent a Consent Form and Plain Language Statement (Appendix B) explaining the study along with an agreement to be audio-taped. These teachers were interviewed in their work environment, mainly outside class time, to avoid interruption and allow the researcher to examine the learning environment. The audio-recorded responses were transcribed and a transcript of their interview given to each participant for comment and clarification. The transcripts were initially scrutinized and coded for analysis. During these interactions with participants, comments, observations and reflections were recorded in journals by the researcher. Permission to use and publish VCAA material was sought so that selected examples referred to in the data could be presented in the Case Reports, Chapter 4 and Cross-case Report, Chapter 5. Permission was granted, see Letter Granting Approval to Use and Publish VCAA Material (Appendix C), and appropriate examples recorded.

The plan outlined is consistent with the constructivist paradigm and is deemed appropriate for this study in that it provides a system of methods and strategies within what Guba and Lincoln (1997) call a “substantive theory” to guide the collection and analysis of data and the interpretation of findings. In the next section the strategies and techniques for collecting, coding and interpreting the data are outlined.

3.4 Collecting the Data

In depth interviews were used to collect data from the participants in this study. Minichiello, Aroni and Hays (2008) describe this as an “appropriate method to gain access to the individual’s words, perceptions and interpretations” (p. 68). For Minichiello et al, the exchange of ideas, observations and perceptions via words is one way in which an individual can know the points of view and meanings of another. The language each interviewee used to express opinions and interpretations they deemed to be important and “of central interest to the researcher” (p. 68), was recorded and transcribed.

The first interview acted as a trial for the set of questions developed along lines described in Patton (2002) as “standardized open-ended” (p. 342) . The taped interview was used to adjust this set of open ended questions and allowed them to be used in all interviews and make comparison across cases (Appendix E). Using standardized questions allowed the researcher to observe and become involved in the in-depth interviewing in a way Guba and Lincoln (1997) characterize as “communicat[ing] respect to respondents by making their ideas and

opinions (stated in their own terms) the important data source for the evaluation” (p.124). In this study the interviewees were viewed as key informants who Minichiello, Aroni and Hays’s (2008) explain, have been “invited to participate because of their knowledge and/or expertise in a particular field” (p. 52).

Discussion with the participants was scheduled throughout the research period to explore themes emerging from data and to identify issues that might arise from interpretations made by the researcher. The results from the field study, the review of literature and notes recorded in the research journals were used to monitor the strategy for this research.

3.5 Coding the Data

The process for sorting through the collected data was based on Strauss and Corbin’s (1990) grounded theory of data analysis techniques described as “a systematic set of procedures” (p. 24). This is a cyclic process of data collection, coding of data into like categories, and reflecting on the findings to determine if more data needed to be collected or the coding modified. This process of recording reflections known as ‘memoing’ was part of the process of refining categories into sub-categories. Memos are defined in Strauss and Corbin (1990) as “written records of analysis” (p. 197). These jottings provided records of the thought processes which for example, explain how phrases in two or more interviews first suggested that a theme was common across those cases. Memo’s also recorded the subsequent thought processes by which the researcher determined whether a theme was a category or sub-category. The data were initially coded for individual participants, recorded in the tables set out in Case Reports, Chapter 4 and presented under the headings of emergent themes, theoretical constructs, and the impact of the Internet. The transcripts were initially scrutinized and coded to find emergent themes and subsequently for features reflecting the theoretical constructs. The process for seeking emergent themes involved creating set of key terms/phrases from an ongoing reading of literature in the field and then scrutinizing each transcript for words and phrases matching those key terms. The process for seeking features reflecting the theoretical constructs involved scrutinizing each transcript for words and phrases matching features expected in online learning activities based on Behaviourist, Cognitive or Constructivist learning theories. The data were then collectively coded in summary tables set out in Cross-Case Report, Chapter 5. The frequency of occurrence of ‘Emergent themes’, ‘Features of Behaviourist/Cognitive/Constructivist’ and themes in the category ‘Impact of the Internet’ presented in the individual case reports were scrutinized. The processes set down in Stake (2006) were used to identify themes and categories common across cases and to reflect on

those themes or categories evidenced in only one or two cases. In particular the data were re-examined, points of convergence and divergence identified and the findings recorded.

The findings, described by Kervin, Vialle, Herrington & Oakley (2006) as “offerings or propositions from the study” were synthesized to form seven conclusions. These are presented in Conclusions, Chapter 6 under the headings of emergent themes, theoretical constructs, and the impact of the Internet.

3.6 Interpreting the Data

The interpreting design chosen for this study was based on what Patton (2002) calls ‘construct’ sampling. It is a design which he describes as useful in “finding manifestations of a theoretical construct of interest so as to elaborate and examine that construct and its variations” (p. 243). This notion is supported by Strauss and Corbin (1990) who note that “choosing the right literature in tandem with doing the analysis” improves the possibility of learning about “the broader and narrower conditions that influence the phenomenon” (p. 55). The decision to use ‘construct sampling’ along with selected literature accords with the decision to utilize the detailed lists of characteristics identified with three major learning theories: Behaviourist, Cognitive and Constructivist and their implications for online learning set out in the Ally (2004) study *Foundations of Educational Theory for Online Learning* and other studies of interest discussed in Review of Literature, Chapter 2. The data collected from the interviewees was examined for manifestations of characteristics identified in the review of literature.

In the Ally (2004) study, for example, the characteristics that derive from Constructivist Learning Theory of interest, are broadly summarised as ‘implications for online learning’ and are listed below:

- Strategies that make learning an active process
- Opportunities for learners to construct their own knowledge
- Environments that encourage collaborative learning.

Components of these characteristics are also identified by Ally and were used to prepare tables of observable features expected to be evidenced in learning environments or instructional material based on one of the identified learning theories. The first tables are presented in the next sections 3.6.1 to 3.6.3 under the headings of Behaviourist, Cognitive and Constructivist.

3.6.1 Ally (2004): Behaviourist Learning Theory

The first theory, Behaviourist is identified by Ally (2004) as producing “observable behaviour that indicates whether or not the learner has learned something” (p. 7). The Ally (2004) study lists the implications for organizing an online environment along Behaviourist lines. These are presented in Table 3.2 below and were used to record examples of Behaviourist theory.

Table 3.2 Features of Behaviourist Theory

Features of Behaviourist Theory Ally (2004)	Observed Features in Data
Learners are informed of learning expectations so they can assess their own performance.	Examples of curriculum documents and policies
Testing is integrated into learning experience to ascertain achievement and provide feedback.	Example of assessment and reporting schedules and or policies
Material is sequenced usually from simple to complex, to promote learning.	Examples of online learning activities used in oncampus learning activities
Feedback allows learners to monitor their own progress and determine an appropriate action.	Examples of online procedures for feedback providing

Ally (2004) noted that the Behaviourist school of thought influenced many early examples of computer instruction. The most well known of these included touch typing tutors used to improve keyboard skills and flight simulators used to train pilots. Typically these programs provided exercises to familiarize the student with the environment, activities to increase the student’s speed in response to stimuli and constant assessment of that familiarity and speed of response. In this research Behaviourist theory was expanded into the four sub-categories of respondent learning, operant conditioning, observational learning and methodological behaviourism in the belief that using these variations to examine data would lead to greater understanding of Behaviourist theory in the environment of interest.

3.6.1.1 Respondent learning

Respondent learning is the first sub-category of Behaviourist learning theory identified by Burton, Moore and Magliaro (2004). To reiterate, they explain that it derives from the theory of conditioned response associated with the techniques of Ivan Pavlov. In many examples of computer instructional material a bell or beep is used as an error alert, and has become by this definition, a negative stimulus. The instructional materials collected from interviewees were examined for evidence of such stimuli and recorded in Table 3.3 below.

Table 3.3 Respondent Learning Stimuli in Instructional Material

Components Burton, Moore and Magliaro (2004)	Observed Features in Data
Noise	Bells, beeps and other auditory alerts
Screen Alert	Messages boxes and/or font colour changes in online learning activities
Monitoring and Reporting	Automated scoring and recording of results. Automated decisions about the next task to tackle.
Prize /Score	Quizzes with score/virtual money rewards or Games with cumulative achievement scored over a number of sessions

3.6.1.2 Operant Conditioning

The second sub-category of Behaviourist learning theory is termed operant conditioning. Burton Moore and Magliaro (2004), explain this is based on the notion that automated learning is a three step learning process of antecedents (cues or signals), operands and consequences. In well designed activities the sequence of cues, operands and consequences are in line with the learning objective. The online instructional materials collected from interviewees were examined for evidence of sequences of cues/signals-operands-consequences and educator control. Table 3.4 shown below was used to record evidence of these behaviours.

Table 3.4 Automated (Operant) Conditioning Educator Controlled

Components Burton, Moore and Magliaro (2004)	Observed features
Automated online activities	Cues and signals, Operands, Consequences
Feedback loop	Repetition of steps identified in testing processes
Educator control	Monitoring and feedback

Burton Moore and Magliaro (2004) also identify three associated sub-procedures of operant conditioning: complex learning; problem solving; and transfer. These are shown in Table 3.5 below. As discussed in the Review of Literature, Chapter 2, the first of these, complex learning, involves practice and working through sequences of steps where one step leads to the next. The second, problem-solving, involves testing the skills and knowledge just learned, for example, in 'what-if' or trial-and-error situations. The third, the transfer component, involves using what you have learned in new situations. Online instructional materials collected from the participants were examined for evidence of these features. Table 3.5 shown below was used to record evidence of these behaviours.

Table 3.5 Antecedents, Operands and Consequences Sequence

Components Burton, Moore and Magliaro (2004)	Observed Features
Complex Learning	“chained behaviours . . . the consequence [of one learning step] takes on a dual role and becomes the stimulus [for the next step] . . . relying on the learner building associations based on the simplest unit [they] have learned in an environment which provides contiguity and utilizes repetition” (p. 12).
Problem Solving	“tactical readjustment to changes in the environment . . . [a] trial and error experience . . . controlling the sequence of material, monitoring the student’s progress and providing appropriate help results in the learner’s ability to generalize (respond the same way to similar stimuli) and discriminate (respond differently to varied stimuli)” (p. 12).
Transfer	“involves the replication of identical behaviours from [one] task . . . to a new task that has similar elements” (p. 12). “discriminate and to generalize . . . central in the processes that enable learning to be adapted and transferred to other environments” (p. 12).

3.6.1.3 Observational Learning

Observational learning is the third sub-category of Behaviourist learning theory and is as already noted, based on the idea that new behaviour can be learned by observing the behaviour of others. Burton, Moore and Magliaro (2004) explain this is also a variety of *vicarious* learning known as Social Learning Theory, which they note, was developed by Bandura (1971) from a series of experiments relating to Observational learning. Bandura extended the notion of learning by simply observing the behaviour of others to making judgements about those observed behaviours.

Elements of observational learning are attention, retention, motor reproduction and motivation. Table 3.6 below was used to record evidence of online learning material that encouraged, or took account of attention, retention, motor reproduction and motivation in the instructional material collected.

Table 3.6 Components of Observational Learning,

Components of Observational Learning Burton, Moore and Magliaro (2004)	Observed Features
<u>Attention</u>	observer’s sensory capacity (perceptual set)
<u>Retention</u>	response patterns and how they are represented in memory in symbolic form
<u>Motor reproduction</u>	organisation of responses on the basis of feedback
<u>Motivation</u>	evaluative judgments that learners make about what they have learned and how it will affect their performance.

3.6.1.4 Methodological Behaviourism

Burton, Moore and Magliaro (2004) outline the relationship between computers and teaching and learning that commenced with the teaching machines of the 1970s. From extensive studies conducted in earlier times to recent examples of Personalized Systems of Instruction

(PSI) models which use the Internet, students' responses to programmed audio visual instructional materials and military training films were observed and analysed. Automated instruction of this type (where monitoring, analysis and feedback are automated computers processes) is known as Methodological Behaviourism. Burton, Moore and Magliaro identify three major components as online question and answer (Q and A) tutorials, the management of complex conferencing and automated administrative procedures. These components and associated behaviours are presented in Table 3.7 below. They were used to record evidence of Methodological Behaviourism in the data collected.

Table 3.7 Components of Methodological Behaviourism

Components Burton, Moore and Magliaro (2004)	Observed Features
Automated instruction	Training videos and audio visual instructional material computers provide control of the sequence of material.
Online Q and A	Responses observed and analysed by computers acting as tutors and programmed to respond to learners' questions.
Automated tutors	Email and video conferencing, computers monitored learners and determined when they needed help, selected the type of help and used the Internet to provide appropriate help.

3.6.2 Ally (2004) Cognitive Psychology Learning Theory

In the study by Ally (2004), Cognitive Psychology Learning Theory (CPLT) is the second major theory related to the design of online instructional material. It contends that learning is an internal process involving the use of memory, motivation, thinking and reflection. To reiterate, they derive from the notion that the amount of learning depends on the "processing capacity of the learner, the amount of effort expended during the learning process, the depth of processing . . ." (p. 7). The main features expected to be observed in instructional material based on (CPLT) are presented as components in Tables 3.8 and 3.9 below. They were used to record evidence of CPLT in the data collected.

Table 3.8 Evidence of CPLT in the Design of Instructional Material

Components Ally (2004)	Observed Features
Strategies to provide learners with information carefully coloured, paced and placed to assist them perceive and transfer it to working memory.	Colour coded online instructional material
Information grouped into generalized categories using information maps.	Structured online learning activities
Strategies to help learners construct a link between information in long term memory and new information.	Consistent use of colour coding in online learning activities

Table 3.9 Evidence of CPLT in Design of Instructional Environments

Components Ally (2004)	Observed Features
Strategies that require learners to apply, analyse, synthesize and evaluate information.	Problem based online activities
Learning materials to suit various learning styles.	Activities using text audio and video
Support materials appropriate to the learner's preferred style.	Options for text, audio and video in activities
Learning material constructed to motivate learners.	Procedures for learners to choose topic/ mode

In a study of cognitive processes Winn (2004) argues that human thought processes cannot be assumed to equate to computer processes. He argues that cognitive activity results from the dynamic interaction between two complex systems namely: a person and the environment. These ideas were discussed in the Review of Literature, Chapter 2 and four sub-categories (System Theory, Biological, Cognitive Neuroscience, and Neural Networks) noted to be referred to in the interpretation of findings, Cross-case Findings, Chapter 5.

In summary, the three components Ally associates with material designed according to CPLT are presented in Table 3.8 and the four components he associates with learning environments based on CPLT are presented in Table 3.9. These tables were combined in Case Reports, Chapter 4 to provide the main framework for recording and analyzing examples of online instructional material in the data. Winn's larger contention that that cognitive activity is not simple or separate from context and that cognitive activity results from the dynamic interaction between two complex systems- a person and the environment was considered during the interpretation of findings in Cross-case Findings, Chapter 5 and Conclusions, Chapter 6.

3.6.3 Ally (2004) Constructivist Learning Theory

Constructivist Learning Theory, the third presented in the examination of online learning theory by Ally (2004), contends that learners learn best in two circumstances. First when they can contextualize what they learn for immediate application, and second, when they learn to acquire personal meaning. The components Ally associated with Constructivist learning are presented in Table 3.10 below and were used to examine data for evidence of an online learning environment based on Constructivist Learning Theory.

Table 3.10 Components of a Constructivist Learning Environment

Components of a Constructivist Environment Ally (2004)	Observed Features
Strategies should make learning an active process.	Collaboration in online learning activities
Learners need opportunities to construct their own knowledge.	Group creation of databases and WIKIs
An environment that encourages collaborative learning should be promoted.	Reports and files shared via email, intranets mobile phones

Other features associated with Constructivist Learning Theory which relate directly to the Internet are listed in Table 3.11 below and were also used to examine the data for evidence of behaviours associated with Constructivist Learning Theory. These characteristics were identified from Ally (2004) and other studies discussed in the Review of Literature, Chapter 2 as advantages of the Internet and online learning.

Table 3.11 Advantages Associated with Constructivist Learning Theory

Advantages Associated with Constructivist Learning Theory Ally (2004)	Observed Features
Access to up-to-date and relevant learning materials.	Open to the Internet
Communication with experts in the field while working on the job.	Reference to technical specifications
Feedback and directing learners to appropriate materials to achieve learning outcomes.	Advice via chats, forums and emails

The researcher notes that these advantages match predictions found in the literature of social change and consequential educational change made earlier by Tofler (1970) and Drucker (1995). Both commentators envisaged a society based on knowledge and educational systems structured around the concept of learning as an ongoing process.

Two other prominent learning theories were also used to assist with the coding of data. First is 'multiple intelligences' discussed in Frames of Mind by Gardner (1983). He provided a list of learning styles, that he described as basic information processing mechanisms. These are shown in Table 3.12.

Table 3.12 Multiple Intelligences and Learning Styles

Multiple Intelligences and Learning Styles Gardner (1983)	Observed Features
Linguistic	Text based
Logical-mathematical	Numerical
Spatial-picture smart	Images and diagrams
Body-kinesthetic	Dance and gymnastics
Musical	Rhythms and beats
Interpersonal-people smart	Collaborations and discussions
Intrapersonal-self smart	Reflections on own learning/decisions
Natural-nature	Exploration and experience

The second is ‘radical constructivism’ summarised by von Glasersfeld (2000) who provided the descriptors shown in Table 3.13. They were used to record evidence of knowledge constructed by individuals related to subjective experience. The notion of knowledge being both constructed and subjective is of interest in this study of online learning because the Internet has the capacity to provide students with the option of selecting their own learning environments and instructional modes.

Table 3.13 Learner-Constructed Learning Environments

Learner-Constructed Learning Environments von Glasersfeld’s (2000)	Observed Features
Knowledge constructed by learners	Databases and WIKIs
Learners selecting their learning environment	Face-to-face or online or virtual options provided in online activities
Learners selecting their instructional modes	Video and audio options provided in online activities

In summary, the three components Ally associates with learning environments designed according to Constructivist Learning Theory and Gardner’s (1983) Multiple Intelligences Learning Styles are presented in Tables 3.11 and 3.12 respectively. They provide the main frameworks for analyzing examples of online instructional material in the data. The characteristics of von Glasersfeld’s ‘Learner-Constructed’ environment, Table 3.13, were considered during the interpretation of findings in Cross-case Findings, Chapter 5 and Conclusions, Chapter 6.

3.6.4 Internet Based Learning: Research Findings

This section outlines findings of selected studies of the online environment under the broad headings of transactional distance, interaction, control and social context. It sets out the processes by which particular elements were identified and utilised to code the collected data.

3.6.4.1 Transactional Distance

Hill, Wiley, Nelson and Han (2004) report on an analysis of Web Based Instruction (WBI) where the instructional material was examined to provide insights into the details of two major components of WBI: structure and dialogue. In their analysis, discussed in the Review of Literature, Chapter 2, they reclassified structure as infrastructure and identified three contributing elements. These are listed as: content expandability; content adaptability and visual layout. These are presented in Table 3.14 below, and were used to interpret the data collected.

Table 3.14 Elements of Infrastructure

Infrastructure Elements Hill, Wiley, Nelson and Han (2004)	Observed Features
Content expandability	Open ended online learning tasks
Content adaptability	Online tasks applicable to a variety of situations
Visual Layout	Consistent heading hierarchy and coherent navigational links

The elements of dialogue were determined to include: academic interaction, collaborative interaction and interpersonal interaction. These are presented in Table 3.15 below, and were used to interpret the data collected.

Table 3.15 Dialogue Elements of Infrastructure

Dialogue Elements Hill, Wiley, Nelson and Han (2004)	Observed Features
Academic interaction	Assessment driven communication via chats, forums and emails
Collaborative interaction	Project based discussions via chats, forums and emails
Interpersonal interaction	Informal discussion via chats, forums and emails

Two additional elements, learner collaboration and learner autonomy, were considered under the headings *Interaction* and *Control*. These are two of the four macro-factors identified as important developments in the context of web-based instruction derived from Moore's initial theory of transactional distance Wiley (2004), discussed in Review of Literature, Chapter 2. Briefly stated, Moore contends that in the instructor-learner relationship, greater distance requires greater control. The notion was mainly associated with distance education and was examined in this research to determine to what extent it applied to oncampus interaction. The researcher initially assumed that students studying oncampus had more opportunity than distance education students to interact with instructors where and when they wished. The components of learner collaboration (Interaction) and learner autonomy (Control) were used to interpret the data collected. The components of each are presented in the next section.

3.6.4.2 Interaction

Hill, Wiley, Nelson and Han's (2004) report identifies four components of interaction as *learner-instructor*, *learner-learner*, *learner-content* and *learner-interface*. These are presented in Table 3.16 and were used to interpret the data collected.

Table 3.16 Components of Interaction

Components of Interaction Hill, Wiley, Nelson and Han's (1994)	Features Observed in Learning Interactions
learner-instructor	Interaction is central to the feedback mechanisms and provides motivation when it is needed.
learner-learner	The exchange of ideas amongst students is promoted.
learner-content	The learning process is defined and includes the 'plan' for providing resources and activities
learner-interface	The learner's ability to use the hardware and software delivering the course is defined.

3.6.4.3 Control

Hill, Wiley, Nelson and Han (2004) argue that control is the most important feature of effective online learning. Their report discussed in the Review of Literature, Chapter 2, separates control into *internal* and *external*. They argue that successful online courses will address *internal* and *external* control as a single component, and help students to understand that success is *internal*. Components of control are listed in Table 3.17 and were used to interpret the data collected.

Table 3.17 Components of Control

Components of Control Hill, Wiley, Nelson and Han's (1994)	Features Observed in the Learning Environment
internal	A belief success is a result of personal accomplishment and effort is promoted
external	A belief success is based on factors outside students' control is promoted
external to internal	Students are helped to understand success is a result of internal control

3.6.4.4 Social Context

The Hill, Wiley, Nelson and Han (2004) report also examines the total environment or social context in which students operate. The social context in an online environment is characterised by Hill et al as made up of complex elements. These are summarised as a shared virtual space that incorporates all the positive features learners associate with responses from real people. Features Hill et al expected to be observed in such spaces are listed in Table 3.18. They were used to interpret the data collected.

Table 3.18 Social Context in Internet-Enabled Learning

Elements of Social Context in Internet-Enabled Learning Hill, Wiley, Nelson and Han (2004)	Observed Features
Virtual space that has the positive attributes of a physical learning space	Games and simulated learning environment with real time response
Hearing from a real person	Real time communications via chat/microphone and video camera
Interactive sound and video built into Internet-based learning experiences	Simulations with audio and video/camera response capabilities
Feeling that others share the learning space and are a part of a learning collaboration	Forums and chat rooms are part of learning activities

3.6.4.5 Hill, Wiley, Nelson and Han (2004) Building Theory from Practice

This section uses ‘findings of interest’ from a selection of studies discussed in the Review of Literature Chapter 2 that examined the design of online and oncampus courses. Hill, Wiley, Nelson and Han’s (2004) report identified four areas of interest: course redesign; assignments; assessment and evaluation of student satisfaction and scalability. They found that course redesign was largely concerned with scalability, in particular, duplicating “face-to-face class experience online” (p. 436). They also recorded teachers’ concerns about plagiarism and automated feedback/scoring. Themes identified in Hill et al’s research, which pertain to teachers’ roles in creating online learning environments, are presented in Table 3.19. These themes were used to interpret the data.

Table 3.19 Faculty Responsibility, Discussion (Online) and Course Requirements

Student Satisfaction Themes Hill, Wiley, Nelson and Han (2004)	Observed Features
Adult Learners want	Prompt and specific feedback. Criticism by phone call not online
Adult Learners do not want	Automated feedback
Learners like	Learning from other learners. Open and honest dialogue.
Learners do not like	Fellow classmates who do not keep up to date with work requirements Discussion/complaints about non-course topics
Learners want	Guidelines and course requirements from faculty. To immediately apply knowledge learned to life situations.
Learners do not like	URLs that do not work. Purchasing books and software not fully utilized by the instructor.

The categories that emerged from Hill, Wiley, Nelson and Han’s (2004) research, together with Gredler’s (2004) discussion of Vygotsky’s (1978) notion that learners need to be conscious of their own thinking in order to develop advanced cognitive and self-regulatory capabilities, were helpful when considering the development of pedagogy associated with online learning environments. In particular was Gredler’s argument that learning situated in virtual and simulated environments should include an explanation the context of the simulation and the learning objective. These concur with elements Hill et al associate with the

category 'Focus on Thinking' and are presented in Table 3.20. They were used to interpret the data.

Table 3.20 Focus on Thinking

Features to Encourage Focus on Thinking Hill, Wiley, Nelson and Han's (2004)	Observed Features
Required interaction/collaboration	Learners are required to use interactive and collaborative technologies data entry
Statement of the desired learning outcome	Learners are aware of and reiterate a specific learning expectation
Explanation of the simulation and its 'associated context'.	Simulations are annotated and activities preceded by quiz of context.

3.6.5 Internet Based Learning Environments

This section utilizes findings from the three studies: Collaborative Learning Environments conducted by Lockyer (2000); Assessing Students' Perceptions of Synchronous Internet-based Learning Environments by Teh (2001) and Building a Profile of the Web Based Learner by Young (2006). They were presented at a series of Australian Association Research in Education (AARE) conferences. Themes which emerged from these studies discussed in the Review of Literature, Chapter 2 were used to interpret examples of online oncampus instructional material produced by the interviewees.

3.6.5.1 Lockyer Study (2001)

Lockyer (2000) examined a plan to move a health education course from face-to-face delivery to online delivery using the Internet. Table 3.21 lists the main elements that Lockyer argues should be include in the plan. These elements were used to interpret the findings.

Table 3.21 Plan for Moving from Face-to-Face to Online Learning

Moving from Face-to-Face to Online Learning Lockyer (2000)	Observed Features
identification of material to be covered	Course outline and assessment expectations online
a shared understanding of what was to be achieved	Exemplar assignments and past exams available online
develop processes for matching collaborative learning activities to appropriate technologies	Students are given options for face-to-face and online collaboration. Continuous evaluation of strategies used
students have adequate access to lectures	Students are given options for face-to-face and online instruction
skills in studentship and facilitating group decision making are taught	Induction processes for using intranets, email, chats and forums

Lockyer's (2000) study provided useful terminology and ideas for discussing pedagogy associated with Internet based learning.

3.6.5.2 Teh's Study (2001)

Teh's (2001) study *Assessing Students' Perceptions of Synchronous Internet-based Learning Environments* examined a survey used to evaluate the relationship between a university computer-lab environment and student outcomes. Three elements of the Teh study are presented in Table 3.22 below. These elements provided useful terminology when interpreting the findings.

Table 3.22 Computer-lab Environment and Successful Student Outcomes

Elements of Successful Student Outcomes Teh's (2001)	Observed Features
<i>Investigation</i> Personal Development	Extent to which skills and processes of inquiry are used in problem solving and investigation.
<i>Innovation</i> System Maintenance [change dimensions]	Extent to which new and varying activities and techniques encourage students to think creatively.
<i>Resource availability</i> System Maintenance	Extent to which the computer hardware and software are adequate.

3.6.5.3 Young's Study (2006)

Young's (2006) study aims to build a profile of the young web-based learner. To reiterate, Young contends that the web affects informal learning and this in turn will change formal learning. In an argument developed more fully in the Review of Literature, Chapter 2, Young (2006) identified the web as a cognitive tool which will influence the individual learner . . . and "[in turn be] influenced by the individual's actions . . ." (p. 4). She derives a theoretical framework from three components of Cognitive Learning Theory: situated cognition; distributed cognition and activity theory. Table 3.23 presents the elements of Young's theoretical framework. These elements were used to interpret findings.

Table 3.23 Profile of the Web-based Learner

Components of Cognitive Theory Young (2006)	Observed Features
Situated Cognition	knowledge gained is "bound by the tools, rituals and physical spaces" making up the learners' environments
Distributive Cognition	evolves from the interaction between "tools, rules, values, artifacts" and the individuals inhabiting the learning environment.
Activity theory	is socially organised practical activity and tool mediated activity that unites the mind with real world activities and events.

Young (2006) identifies activities, curriculum and "interpersonal relationships as elements of the learning environment" (p. 9). She uncovers three primary themes and develops five secondary categories. The processes by which they emerged are discussed in the Review of Literature, Chapter 2. The primary themes and secondary categories that were considered of useful for this study are presented here in Tables 3.24, 3.25, 3.26 and 3.27.

Table 3.24 Profile of the Young Web-Base User

Participant Citizen Young (2006)	Tool-Mediated Citizen Young (2006)	Adaptive Citizen Young (2006)
Global Citizen Commercial Citizen Communicative Citizen Abiding Citizen	Technician Security Guard Integrator Design Analyst	Efficient Worker Researcher Director

The three tables below provided this researcher with the opportunity to examine a systematically developed framework and associated vocabulary to clarify coding decisions made during the search for themes, categories and sub-categories associated with a web-based learner. Table 3.25 below displays selected descriptors Young (2006) developed for the category Participant citizen.

Table 3.25 Selected Descriptors of a Participant Citizen

Participant Citizen Young (2006)
Global Citizen Understanding of their community in Australia and Australia as part of the world Awareness that language variations occur across cultures Communicative Citizen Use of email Use of chat rooms and messenger services Understanding iconic representations Abiding Citizen Engaging in socially accepted practices

Table 3.26 below displays selected descriptors Young developed for the category Tool-Mediated citizen.

Table 3.26 Selected Descriptors of a Tool-Mediated Citizen

Tool-Mediated Citizen Young (2006)
Technician Efficient practices Security Guard Using logins and passwords Awareness of safety issues Integrator of various human senses of different online and offline activities of available hardware and software Design Analyst Analysis of various web site layouts Interpreting displays and graphical representations Understanding of use and limitation of the web Understanding of skills and knowledge required or facilitated through web usage

Table 3.27 below displays selected descriptors Young developed for the category Adaptive citizen.

Table 3.27 Selected Descriptors of an Adaptive Citizen

Adaptive Citizen Young (2006)	
Researcher	
Search for information	
Navigate through sites	
Comparison of tools for purpose	
Director	
Flexibility	
Persistence	
Focus	
Personal preferences	
Self regulation/ Self monitoring	

Importantly, for this study of VCE information technology teachers, the categories which emerge from Young's study offer descriptors of young web-based users that inform the decisions made during in the analysis processes.

3.6.7 Online Instructional Material and Teachers

This section outlines findings of selected studies of the online environment under the two broad headings of online instructional material and the teacher. It identifies the elements selected from those studies that were used to interpret the data collected.

3.6.7.1 Online Instructional Material Design

Peacock and Cleghorn (2004) argue that instructional texts designed to meet the expectations of learners and teachers have identifiable features (discussed more fully in the Review of Literature, Chapter 2). These are described as elements that online instructional material designed for a global market should incorporate. They are presented in Table 3. 28 and were used to help make coding decisions and interpret the data collected.

Table 3.28 Implications of Globalisation on Instructional Material

Design Elements in Instructional Material Peacock and Cleghorn (2004)	Observed Features
The cultural difference among learners is acknowledged in the prescribed curriculum, the pedagogy and the perceptions of teachers	Activities allow for culturally diverse locations and concerns
Text in teaching clarifies teachers' and learners' notions of training needs	Introductions specifies learning outcomes and assessment requirements
Techniques for improving text quality are evident	Images, annotations, diagrams, labels and online links to references support text
New forms of learner-text interaction are explored	Audio and video options for are available

Peacock and Cleghorn's (2004) close examination of the traditional Teacher-Learner-Text relationship identified the three components set out in Table 3.29 below. These were used to make coding decisions and interpret the instructional material collected in this research.

Table 3.29 Components of the Teacher-Learner-Text Relationships

Relationships Peacock and Cleghorn (2004)	Dimensions
Teacher-Learner	teachers' attitudes . . . in culturally diverse settings
Teacher-Text	the role the text is perceived to play
Learner-Text.	the potential for text to affect conceptual change in learners

The findings of Walpole and Smolkin (2004), Peacock and Cleghorn (2004), and Barba (2004), link the notion of 'considerate' or 'friendly' texts with that of visual literacy. Considered together with Ally's (2004) findings they offer many well developed principles for the designers of online instructional material.

Walpole and Smolkin (2004) for example, divided the instructional material into 'considerate' and 'inconsiderate' texts. Peacock and Cleghorn (2004) in another study identified a number of elements found in 'considerate' and 'inconsiderate' texts. To reiterate, they contend the information presented in a straight forward structure is an effective choice for independent learning because students get a chance to build cognitive strategies before they are confronted with less considerate texts. Similar elements traditionally associated with 'considerate' instructional material are also outlined by Barba (2004) for the purpose of identifying and designing 'friendly web-pages'. Barba lists only two features appropriate for an online environment: links and navigational devices. The findings from these three studies were collated and are set out in Table 3.30. They were used to help make coding decisions and interpret the data.

Table 3.30 Elements of Considerate and Inconsiderate in Texts

Text Elements Walpole and Smolkin (2004), Peacock and Cleghorn (2004), Barba (2004)	Observed Features
Considerate texts	Introductions, headings and sub-headings tables outlining the structure of texts pronouns and conjunctions to enhance understanding. straight forward navigation.
Friendly web pages	Links and navigational features
Inconsiderate texts	Information disrupts the global coherence Text presented in zig-zag fashion

Walpole and Smolkin (2004) in particular, directly address visual literacy in the learning activities that they examined. They argue that the reader must be alerted to titles, questions and images to ensure they are used in the learning process. Selected features Walpole and Smolkin associate with visual literacy are listed in Table 3.31. These were used to examine and interpret online learning material collected from interviewees.

Table 3.31 Selected Features to Facilitate Visual Literacy

Visual Literacy Walpole and Smolkin (2004)	Observed Features
translate visual images into verbal language	Activities which require descriptions of the information conveyed by diagrams/images
translate verbal language into visual images	Activities which require construction of maps, diagrams and symbols to convey information presented verbally
Alerts for titles	Activities with consistent formats or modes for titles
Alerts for questions	Activities with consistent formats or modes for questions
Alerts for images	Activities with consistent formats or modes for images

3.6.7.2 The Role of the Teacher

Cox (2003) proposes three scenarios for the teacher-to-student interaction in an online environment: *face-to-face*; *hybrid* and *distributed teacher* along with characteristics of each. These scenarios and their associated characteristics are discussed in the Review of Literature, Chapter 2. The characteristics used to describe the *hybrid* scenario provided a vocabulary deemed appropriate for this study of learning environments that are both online and oncampus. The characteristics proposed by Cox are presented in Table 3.32 below and were used to interpret findings resulting from the coding processes described in this chapter.

Table 3.32 Selected Scenarios

Teacher-to-Student Interaction Cox (2003)	Likely Characteristics of Instruction Scenarios
Hybrid Learning	<p>Learning is both face-to-face and at a distance.</p> <p>Instruction takes place in a building with flexible space and electronic facilities that extend the capacity to organise flexible time.</p> <p>Teams of teachers create a learning space.</p> <p>Teachers share “learning strategies, materials, techniques, resources . . . with colleagues both local and distant” (p. 205).</p> <p>Teachers act as “the Hub” at the centre of complex interactions between students, culture, language, other teachers, media experts, and educational authorities.</p> <p>Teachers cater to the diversities of students’ needs by adapting teaching strategies to suit the students’ backgrounds and aim to empower students as independent learners with the ability to adapt.</p>

3.7 Conclusion

The research design for this study has been presented in this chapter. This includes the decision to study each VCE IT teacher as a unique case, using a set of standard set of open ended questions and the purposive selection of interviewees. The participants are studied as instrumental cases and then collectively as a multiple case study. The processes for analysis and interpretation involved identification of themes from words and phrases that appeared in the transcripts of interview, and cross-referencing these with categories derived from theoretical constructs and pertaining to the design of online instructional material and from online government publications relating to the VCE curriculum. The research design was followed to increase the researcher's understanding of each participant's perceptions of the online learning environment in which he/she operated. The analysis across cases was pursued to help make comparisons between the individual case and the collective case.

The next chapter Case Reports Chapter 4, documents the results of the eight individual information technology teachers' data. It presents eight individual case reports.

Chapter 4 Case Reports

4.0 Introduction

There are eight case reports documented in this chapter. The data are based on transcripts of interviews, examples of online learning instructional materials and observations collected by the researcher during this study. The case reports involve eight experienced Information and Communication Technology (ICT) teachers who agreed to participate in this research. Each interview commenced with eight open ended questions (Appendix E) which were discussed in detail in Methodology, Chapter 3.

4.1 Case Catherine

Catherine was the Information Communication Technology (ICT) manager at a secondary college in Victoria and a leading exponent in the use of ICT for collaborative learning. She was teaching two Year 12 VCE classes. One class studied the use of application software programs such as FrontPage, Access and Excel in organisational environments and the other class studied programming. Both syllabi VCAA (2006a) set problems where students use ICT within a “problem solving methodology” (p. 50) to solve tasks in contemporary organisational environments.

At the beginning of the first interview session (AInt-00-00), Catherine outlined three broad objectives for increasing the use of ICT in the school. The first objective involved increasing opportunities for students to access computers and the Internet, the second to encourage teachers to put class notes up on the school’s network and the third was to promote collaborative online learning. Catherine referred to these objectives throughout the interview and they served as a framework for many of her responses to the eight initial opened questions.

4.1.1 Emergent Themes

When the data collected from Catherine were examined the three objectives emerged as themes.

i First emergent theme: increasing students access to computers and the Internet,
Catherine’s strategy to achieve the first objective was to increase the number of classes where students could access the subject notes from the school’s network and submit their class work and homework using email. She observed that students in her own classes had quickly adapted to having their subject notes online and that they particularly liked the option provided by email of completing work when it suited them. Catherine typified the student

perspective as “I don’t want to work now I’ll do it at home” and believed students preferred to organise their work in what she called “*time-shift*.” (ATran-1040) As Catherine explained where students can access topic notes, activities and exercises from the school’s website and because they can find additional information from the Internet they often prefer to investigate and complete tasks when it suits them. They socialise in class where there are other students with whom they can discuss work and then complete the more demanding thinking and writing exercises when they are alone at home.

ii Second emergent theme: encourage teachers to use the school’s network

The second objective was to get more teachers to put their class notes up on the school’s network. She noted that for many teachers the notion of students working in the *time-shift* mode was difficult. “And that’s got challenges for teachers who like kids to be in class and working on task all the time.” (ATran-1041) As ICT manager, she had installed a widely used software package called MOODLE on the school network to provide a filing structure to manage the class notes. MOODLE is a popular file management software package used by many secondary schools in Victoria and recently endorsed by the Department of Education and Training (DET) now the Department of Education and Early Childhood Development (DEECD). MOODLE provides among other things a standard format for teachers to present their notes and a hyperlinked table of contents to facilitate navigation for students. As a rule the teachers who were already putting their notes onto the school’s network used PowerPoint to create lessons irrespective of the file management software. Catherine believed this was because PowerPoint was very easy for teachers to use. “It’s quick, yes. You can knock up a tutorial with PowerPoint” (ATran-799). Catherine described the control that the program exerted over the sequencing and sound as a limitation for teachers using PowerPoint but believed for many tasks it was “probably the easiest way . . . of preparing online stuff for kids”(ATran-810).

Catherine read widely and regularly in the field of online learning and recalled that the University of Tasmania used PowerPoint for their online learning because it provided the “interactively [to] . . . go from topic to topic and back again” (ATran-781). In an assessment that considered a number of other software packages, including the very popular animation program Flash, she judged this limited linear interactivity of PowerPoint as “very effective” but thought that “with so much choice I’m not sure which one’s the best.” Catherine had tried to write a tutorial for Flash herself but found it difficult to produce a complete set of exercises to the standard she wanted. “I ended up writing one for one of our bright boys last year, that got him into the first three bits and the first three exercises, and then I couldn’t go any further” (ATran-670). At that stage she found a website www.flashclassroom.com established by the

Queensland Education Department and what she judged “a fabulous tutorial” (ATran-669). This is discussed in more detail in section 4.1.2.1 which examines the online tutorials for elements associated with Behaviourist theory.

Catherine’s strategy to encourage staff to experiment with online learning derived from her belief that teachers had to use ICT for their everyday tasks before they would use it in their classrooms. She had made the Internet easily accessible for all staff in the belief that if teachers used computers in their daily work they would realize that “everybody needs to access ICT in their normal work” (ATran-937). Catherine hoped that teachers would eventually promote increased computer use in the wider community “start the community within staff in schools Get them sharing and also learning about online communication” (ATran-933). In her experience, as an ICT specialist in secondary schools, she had observed that teachers were “pretty reluctant to engage” (ATran-935). They could not see immediately how an online activity related to what they did in the classroom. In the hope that this might change once teachers had experienced the advantages, Catherine had decided to “put everything online, all the documents for the school are online. I’ve got contributions to the school bulletin and the newsletter going online, but they’re also still going on paper” (ATran-935).

Catherine believed that reluctance to engage with computers was in some cases generational “that people who haven’t grown up with the technology find it difficult to realize what it does for them . . . [and because they have grown up with books] still think kids need to read books” (ATran-967).

iii Third emergent theme: promote collaborative online learning.

Catherine had formed a learning partnership with a secondary school in Lyon France to encourage collaborative online learning and meet her third objective. “to get the kids in collaborative online learning with other schools. And I mean true collaborative online learning – I’m doing that with WKTI in France” (ATran-1092). Catherine had visited the school in Lyon and spoken to the French students about what they were doing. Students worked in teams formed from thirty countries around the world. Each team was made up of students from four or five other countries, and “they were communicating with each other by their WIKIs and Forums”(ATran-1122). Catherine observed that “they were having a great time, . . . and learning a lot about language and communication online, which is quite different from face-to-face . . . ”(ATran-1124). As an afterthought she noted that the students were learning about “a topic of interest to the world as well” (ATran-1127). The learning

partnership with the worldwide community had been running for two years and was undergoing an evaluation.

At the time of interview a small number of teachers in Catherine's school were accepting class work and homework from students via email and the school was in the early stages of setting up MOODLE, the software package to manage course material online. "We're using MOODLE . . . and it took us about two months to figure out how to use it and to get it working" (ATran-100). Some course material was already being used via the network and Catherine believed that using MOODLE was easier than looking for folders on a complex network. "It's got a better interface for the kids" (ATran-105).

Themes discussed in this section were derived from Catherine's stated objectives. In the next section theoretical considerations discussed in the Review of Literature, Chapter 2 were used to examine her responses, the artifacts collected and field notes made by the researcher.

4.1.2 Theoretical Framework

Catherine's responses were read for examples of characteristics of observable features expected to be evidenced in learning environments or instructional material based on one of three major learning theories identified by Ally (2004). The results are presented under the headings of these learning theories: Behaviourist; Cognitive and Constructivist.

4.1.2.1 Behaviourist

Behaviourist theory discussed in Chapter 3 Review of Literature is identified by Ally (2004) as producing "observable behaviour that indicates whether or not the learner has learned something" (p. 7). As noted earlier Catherine had discovered that the Queensland Education Department had developed the Flash Classroom online tutorials after she tried unsuccessfully (in her judgment) to write activities. She described these tutorials as "brilliant, [and] extremely well written. The kids had no problem reading them and following them . . ." (ATran-825). The examples of online instructional materials described by Catherine are listed under categories that Ally associated with Behaviourist theory and are presented in Table 4.1 below.

Table 4.1 Catherine: Features of Behaviourist Theory

Features of Behaviourist Theory Ally (2004) expected in online instructional material	Online learning activity discussed by Catherine from Flash Classroom Tutorial 1
“Learners are informed of learning expectations so they can assess their own performance” (p. 7).	“In this tutorial you will learn how to use traditional techniques to create an animation sequence in Flash” (p.1).
“Testing is integrated into learning experience to ascertain achievement and provide feedback” (p. 7).	“Make a Traditional Animation” In Flash 8” Step 5 “. . .you will see that there is a picture of your animal. Click on Frame 2 and you will see the same picture”(p.1).
“Material is sequenced usually from simple to complex, to promote learning” (p. 7).	Make a Traditional Animation In Flash 8, Step 1 “To begin draw a character of your choice in the stage. My example above shows a bear that I have created using a number of oval shapes” (p.1).
“Feedback allows learners to monitor their own progress and determine an action” (p. 7).	Make a Traditional Animation In Flash 8, Step 7 “You can check your short animation by selecting Control> Test Movie. Your image will change quickly as the animation moves through the 2 frames” (p. 2).

The Flash Classroom tutorials found at www.flashclassrooms.com were examined and found to exhibit all the four features set down in Table 4.1 and described by Ally (2004) as consistent with instructional material based on the Behaviourist learning theory. First, the introductory screen shown below in Figure 4.1 sets out the learning objectives of each stage of the tutorial.

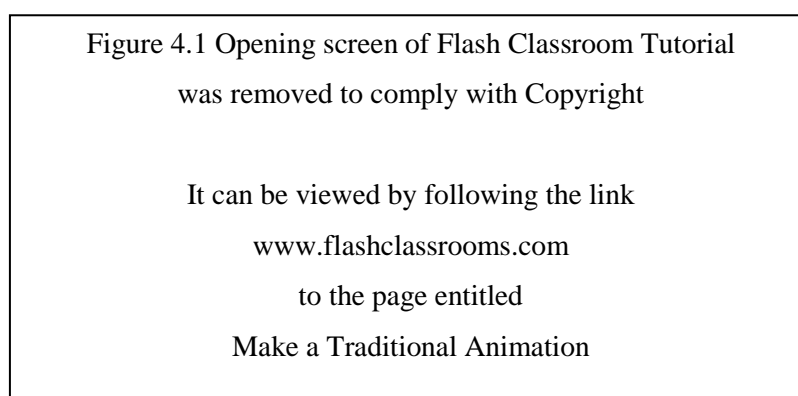


Figure 4.1 Opening screen of Flash Classroom Tutorial

Secondly, when a task is completed according to the instructions and the student runs the animation they are both testing their learning and receiving feedback automatically. It is built into the learning experience because to test that the animation operates correctly students have to read the feedback. Thirdly, the tasks are sequenced from simple to complex. This initial instruction, which provides students with an example they can copy if they lack the confidence to create their own character, is followed by a sequence of 10 instructions of increasing complexity. This is illustrated in Figure 4.2 below: Step 6 “To create the

animation, we simply need to change the image of Frame 2. You can adjust your animal's mouth or face by selecting the black arrow tool and moving it close to the mouth or other facial feature”

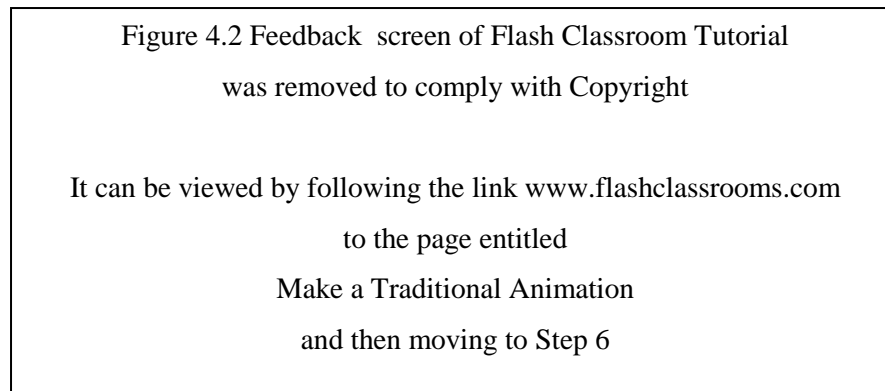


Figure 4.2 Feedback Screen of Flash Classroom Tutorial

Fourthly, at each step, the learner receives feedback and can monitor his/her own progress and determine an action.

The Flash Classroom tutorial has exercises to familiarize students with the environment in the same way the early touch typing tutors used similar sequencing and feedback associated with Behaviourist learning theory. But unlike the typing tutors, which provided vocational training and were sequenced to increase the students' typing speed in response to stimuli and provide constant assessment of that familiarity and speed of response, the FlashClassroom tutorial aims to increase the students' skill with an animation design tool. More importantly students are free to choose their own context and follow their own interests when developing the skills.

In of Literature Chapter 2Review, Burton, Moore and Magliaro (2004) expanded Behaviourist theory into the four sub-categories of respondent learning, operant conditioning, observational learning and methodological behaviourism. The Flash tutorials found at www.flashclassroom.com were examined and examples of respondent learning, operant conditioning and observational learning were found. These are presented in Tables 4.2 to 4.3.

4.1.2.1.1 Respondent Learning

Respondent learning, the first sub-category of Behaviourist Learning Theory is associated with Ivan Pavlov's techniques of conditioned response. From the Review of Literature Chapter 2, Burton, Moore and Magliaro (2004) describe the process as one where learners are

gradually trained to respond to what is initially a neutral stimulus such as a whistle. They noted that in many examples of computer instructional material a bell or beep was used as an error alert and therefore a negative stimulus. The Flash tutorials were examined for evidence of conditioned responses and the results recorded in Table 4.2 below. The data suggested that this type of negative alert had not been utilized by the creators of the software within the learning environment they had created. There were however, negative alerts observed but these were the noise and text messages which come with the operating system and warn users when an action may cause loss of data. They are found universally in a standard Microsoft computing environment. There was what the researcher considered a positive conditioned response in the form of a score.

Table 4.2 Catherine: Evidence of Conditioned Responses in Instructional Material

Features of conditioned responses expected in instructional material Burton, Moore and Magliaro (2004)	Features observed by the researcher when running the online learning activities
Noise	Standard Microsoft noise alerts are used as negative signals for standard errors
Screen Alert	Standard Microsoft screen message box alerts provide users with reasons for standard errors
Monitoring and Report	Standard Microsoft reports available users with knowledge of the advanced features of Windows
Prize /Score	“You should now be able to use Flash to create simple animation sequences using the traditional technique.” (p.1) Flashclassroom Tutorial Make a Traditional Animation In Flash 8

4.1.2.1.2 Operant Conditioning

The second sub-category of Behaviourist learning theory is outlined in the Review of Literature Chapter 2 as Operant Conditioning. A tutorial reflecting this theory would have an automated sequence of cues, operands and consequences in line with a stated educational goal. From Burton, Moore and Magliaro (2004) the consequences of a learning activity would be monitored (observed) and the cues repeated in a feedback loop known as ‘schedules of reinforcement’ (p. 11). The Flash tutorials were examined and showed only very little evidence of automated sequences of cues/signals-operands-consequences and not of the type of educator control described by Burton, Moore and Magliaro (2004) as typical of operant conditioning.

Three associated sub-procedures of the ‘cue-operand-consequence’ sequence identified by Burton, Moore and Magliaro (2004) in the Review of Literature as complex learning, problem solving and transfer were evidenced in the Flashclassroom tutorials. Burton et al (2004) contended that learning activities characterised by a “practice of contiguous chained behaviours” developed complex learning. This is evidenced in the tutorial *Make a Traditional*

Animation in Flash 8 where Step 8 takes on a dual role: it is a consequence of Step 7 and the stimulus for Step 9.

The content of this tutorial was then examined for evidence that the activities developed problem solving strategies by providing what Burton et al (2004) characterised as “trial and error experiences” (p. 12). This is illustrated by Step 6 in the same tutorial. Activities of this type require learners to solve problems by making what Burton et al (2004) call “tactical readjustment to changes in the environment” (p. 12).

The third component is transfer and it “involves the replication of identical behaviours from [one] task . . . to a new task that has similar elements” (p. 12). It is evidenced in Step 10 “You should now be able to create simple animation sequences The next tutorials cover different animation techniques” (p. 2). The twelve tutorials listed under the Learn Flash menu found at www.flashclassrooms.com were examined for similar evidence. The design for the tutorials provided learning activities created to develop complex learning, problem solving and transfer of learned skills and knowledge. Table 4.3 shown below records results selected as typical of the ‘cue-operand-consequence’ sequence identified by Burton, Moore and Magliaro (2004) and found in the tutorials described by Catherine.

Table 4.3 Catherine: The antecedents (cues or signals), operands and the consequences sequence

Features of Operant Conditioning expected in instructional material Burton, Moore and Magliaro (2004)	Features in the Flashclassroom Online Tutorial 1 Used by Catherine
“Complex Learning: chained behaviours . . . through practice and contiguity, the consequence takes on a dual role and becomes the stimulus mechanism as relying on the learner building associations based on the simplest unit they have learned in an environment which provides contiguity and utilizes repetition” (p.12).	Step 8 “You can make your animation even longer by adding more key frames and changing your character’s expression in each frame” (p. 2). Step 9 “Save your animation by selecting File>Save. This will create the .flat file that you can open in Flash if you want to edit your animation” (p. 2).
Problem Solving: “tactical readjustment to changes in the environment . . . [a] trial and error experience . . . the capacity to . . . controlling the sequence of material, monitoring the student’s progress and providing appropriate help results in the learner’s ability to generalize (respond the same way to similar stimuli) and discriminate (respond differently to varied stimuli)” (p.12).	Step 6 which includes “. . . You can adjust your animal’s mouth It will change and you will be able to alter the mouth or feature’s shape” (p. 2).
Transfer : “involves the replication of identical behaviours from [one] task . . . to a new task that has similar elements” (p. 12). “discriminate and to generalize . . . central in the processes that enable learning to be adapted and transferred to other “environments (p. 12).	“You should now be able to create simple animation sequences The next tutorials cover different animation techniques” (p. 2).

4.1.2.1.3 Observational Learning

The third sub-category of Behaviourist Learning Theory is Observational learning. It is based on the idea that new behaviour can be learned by observing the behaviour of others. Burton, Moore and Magliaro (2004) note this is also known as *vicarious* learning and derives from Social Learning Theory where learners observe “other people’s behaviour and its consequences for them” (p. 12). Catherine’s descriptions of student-student and student-teacher interactions in her computer classrooms evidenced observational learning as did her references to learning materials. These are presented in Table 4.4 below to illustrate the components of observational learning: attention; retention; motor reproduction and motivation.

Table 4.4 Catherine: Components of Observational Learning

Features of Observational Learning Burton, Moore and Magliaro (2004) expected in instructional material	Features of Observational learning described by Catherine
<u>Attention</u> Observers’ sensory capacity (perceptual set) “Learners should be told why they should take a lesson so that they can attend to the information throughout the lesson” links to both simpler and more complex material can be used to accommodate learners at different knowledge levels” (p. 11).	“The kids loved it. Year 10 kids got into it straightaway” (ATran-849).
<u>Retention</u> “response patterns and how they are represented in memory in symbolic form” (p. 11).	“Well the kids can just go through it, and it starts off with really interesting stuff, not boring” (ATran-843).
<u>Motor reproduction</u> “organisation of responses on the basis of feedback” (p. 11).	“I had no queries about ‘how do you understand this?’ or ‘what does this mean?’ It was really well written, so that was great” (ATran-849).
<u>Motivation</u> “evaluative judgments that learners make about what they have learned and how it will affect their performance” (p. 11).	And they teach me too, they say “we’ve got something to show you,” and they call me over and . . . (ATran-C846)

In summary the instructional material and learning environments described and praised by Catherine do exhibit features associated with Behaviourist Learning Theory, especially those which promote complex learning, problem solving and the capacity to transfer learned skills and knowledge to new situations. In the next section artifacts collected from Catherine and her comments in the transcripts of interviews were examined for evidence of online instructional material associated with Cognitive Psychology Learning Theory (CPLT).

4.1.2.2 Cognitive

Cognitive Psychology Learning Theory (CPLT) discussed in Chapter 2 Review of Literature is identified by Ally (2004) as internal learning processes involving the use of memory, motivation, thinking and reflection. Their research suggests that learning material designed for online learning which utilised CPLT would exhibit identifiable features such as those listed in Table 4.5 below. The researcher examined learning material created for the Australian Children's Television Foundation (ACTF). Catherine had worked for the ACTF and described the ongoing difficulties she encountered with producing online material that used colour, sound and movement. "I couldn't get beyond the animation. I had a great deal of trouble understanding the framing and that stuff, which is really odd, because I worked at the ACTF for over fifteen months and played with Premier . . ." (ATran-745).

Table 4.5 Catherine: Features of CPLT Observed in Online Learning Material

Features Ally (2004) expected in online learning material based on the CPLT	Features observed in instructional material artifacts collected from Catherine
information carefully coloured, placed and paced to assist them perceive and transfer it to working memory.	The Flash Classroom tutorials show a colour strip of dark rust red accompanying the sequence of learning instructions (p.1).
Information . . . grouped into generalized categories using information maps.	Catherine pointed to a learning activity developed by Kahootz, an offshoot of the Australian Children's Television Foundation (ACTF). The ACTF's Learning home page has coloured shapes with titles/links to major sections.
help learners construct a link between information in long term memory and new information	Catherine explained Lesson 2 Australian Children's television Foundation www.actf.com.au
require learners to apply, analyse, synthesize and evaluate information.	Catherine pointed to an open ended learning activity developed by Kahootz. The extension activity linked to Australian Children's Television Foundation. www.actf.com.au
materials . . . to suit various learning styles.	Catherine referred to video and audio in a learning activity developed by Kahootz, Lesson options in the Australian Children's Television Foundation. www.actf.com.au
Support materials . . . appropriate to the learner's preferred style.	Extension activity with video and/or audio were linked to Australian Children's Television Foundation. www.actf.com.au
Learning material . . . constructed to motivate learners.	Catherine explained narrative /storytelling and images constructed from users personal photographs found on Australian Children's Television Foundation www.actf.com.au

In summary the instructional material and learning environments produced by the ACTF and demonstrated by Catherine do exhibit features associated with CPLT. In particular, the careful placement of colour to assist memory, the grouping of information into generalized categories and the provision of materials to suit various learning styles. The evidence that it helps

learners create links in long term memory and new information and that it is constructed to motivate learning is discussed more fully in section 4.1.3 Education and the Internet. The notion that the amount of learning depends on the “processing capacity of the learner, the amount of effort expended during the learning process, the depth of processing . . .” (p. 7) which Ally (2004) associates with CPLT, is also discussed in relation to material by the ACTF (www.actf.com.au).

4.1.2.3 Constructivist

Constructivist Learning Theory is discussed in Chapter 2 Review of Literature. From Ally (2004) this theory contends that “learners learn best when they can contextualize what they learn for immediate application and when they learn to acquire personal meaning” (p. 7). Table 4.6 below sets out features expected to be found in a constructivist learning environment. Catherine had worked with a teacher in NSW to establish a Virtual Private Network called BeyondBorders ([www. MOODLE.nbcs.nsw.edu.au/beyondborders/2006](http://www.MOODLE.nbcs.nsw.edu.au/beyondborders/2006)). This site provides an online international learning environment for her students. The researcher examined both artifacts from the website and Catherine’s descriptions of students using Beyond Borders for evidence to support the notion that this learning environment fitted with Constructivist Learning Theory.

Table 4.6 Catherine: Features of Constructivist Observed in Online Learning Material

Features Ally (2004) expected in a learning Environment based on Constructivist Learning Theory	Features found in Catherine’s descriptions of the online Learning environment of Beyond Borders
Strategies to make learning an active process.	“ . . . you get a number of kids, teams of three kids from each school in different countries – so if you’ve got twenty one kids in a grade, that’s up to seven countries you can have involved. And those kids work with the other kids in the other countries to investigate frogs in rivers. And they go investigate them in their own town, they put the information up on their WIKI . . . and then the kids email each other with questions and answers” (ATran-1167).
Opportunities for learners to construct their own knowledge.	“ . . . it’s continual, and there’s a Forum as well where they can write their questions. [such as] Oh, I didn’t understand what you said about your frogs” (ATran-1182).
An environment that encourages collaborative learning is promoted.	“Well it’s important because you’ve got kids actually engaging with each other while they’re doing the research, rather than sitting here quietly” (ATran-1187).

With respect to Beyond Borders, Catherine judged the collaboration was “working really well. . . .the kids are from different cultures and they’re all communicating in English . . . that’s the only common language . . . and so they’re having difficulties with that as well. And

so they come back and say ‘well I didn’t understand that . . . what did that statement mean?’ ” (ATran-1202).

In the next section 4.1.3 the artifacts, observations and comments by Catherine were further examined for influences she believed were brought by the Internet.

4.1.3 Education and the Internet

For Catherine the Internet provided

- i. access to learning activities organised to her standards*
- ii. access to other like-minded teachers and collaborative projects*
- iii. communication capabilities to facilitate a global classroom and broaden learners experiences*

Catherine found on the Internet, a repository of what she judged to be, high quality interactive instructional activities that enabled her students to learn the programming techniques set down as key skills in the *Information Technology VCE Study Design VCAA* (2006).

Catherine headed a team of teachers at the Television Children’s Foundation employed in a project to develop and collate online learning material to address the literacy, numeracy and technology components found across subject areas.

Catherine, together with her students, utilised the Internet to become part of an international online learning community. The online conversations she observed between Australian and French children were often characterised by misunderstandings about ordinary everyday experiences, and are reflected in Young’s (2006) notion of *Situated Cognition* and her reference to Barab and Plucker (2002) who conclude that “effective learning occurs when it is situated in authentic activity . . . [the] ordinary practices of culture . . . ordinary people doing ordinary things” (p. 6).

4.2 Case Alan

Alan was the head of Information Communication Technology (ICT) at a large private secondary college in a beautiful rural setting in Victoria. Alan was teaching a Year 12 VCE ICT class. In the previous ten years he had taught the same ICT subjects at an inner city secondary college where students were selected after sitting for an entrance exam.

In Alan's introductory outline of his school's ICT environment he described the school's Intranet as "document sharing in [a] system with messaging built-in." (BTran-78). At the time of the first interview the school network was moving from a system where most teachers could read most documents but not create documents, to one where teachers were encouraged to create and post documents. The new system called *eworkspace* he characterised as "... global share [and] basically more effective ... document based as well" (BTran-79).

Alan explained that the ICT subjects currently offered had evolved from the teaching preferences of previous ICT staff. "The previous guy set up a Year 10 programming class ... and basically in that respect we spend half the year on VB [Visual Basic general programming language] and half the year on Flash [Multimedia software]" (BTran-26). In his descriptions Alan referred to VET Multimedia and VCE Software Development to distinguish between subjects offered as part of Vocational Education Training (VET) and subjects offered as part of the Victorian Certificate of Education (VCE). The VCE subjects contributed to a tertiary entry score, the VET subjects did not.

Formal programming was offered at Year 10 to try and prepare students for the more rigorous programming requirements of the VCE Software Development curriculum where. . . "you've really got to understand the programming and not just 'fish' around the edges" (BTran-48). In his opinion many students enrolled in the Year 10 programming class as what he called a 'filler' but found it difficult and did not "put that much effort into it" (BTran-55).

Alan was concerned that the newer version of the coding language used in Flash, Action Script 3 did not contain the built in code of the older version Action Script2. This meant students had to sometimes create difficult code segments to add properties to objects – to add colour to a square for example. As a consequence Alan and his colleague in the school's ICT department had to create some coding to enable the Multimedia students to meet learning outcomes associated with

artistic creativity. “The new Action Script 3 is apparently a lot more like Java [a complex general programming language] and is therefore quite difficult to work in for ‘arty’ people which is what Multimedia was designed for Our young IT staff member says he finds Action Script 3 quite difficult”(BTran-34). He believed that as a consequence of this change, using Flash and Action Script 3 to write interactive instructional material had become much more difficult for teachers. “Yes it’s not like JavaScript . . . [the relatively straight forward code used to control web pages] . . . you see in Flash- Action Script 2 a lot of the constructs are already there as embodied objects whereas in Action Script 3 you have to write all the code . . . to interact with it” (BTran-43). In a later comment Alan estimated that it would take 300 hours of work to create and trial one hour of effective interactive learning material and added “to produce really good stuff you’re looking at 600 [hours]” (BTran-547).

In summary, Alan framed the majority of his responses in terms of students’ responses to various models of instructional material. The examples he cited were activities and exercises he had developed or adapted for the Software Development Course in the *Information Technology VCE Study Design* VCAA (2006a) and the VET (Vocational Education Training) Multimedia syllabus. The interviews, follow-up conversations, observations and artifacts were then read and re-read for emergent themes and for evidence to fit with the theoretical framework set out in Methodology, Chapter 3.

4.2.1 Emergent Themes

For Alan providing students with stimulating activities was central to creating successful online instructional material, and this emerged as the dominant theme of the interview.

Emergent Theme: Creating Online learning Activities that Engage Students

He believed the key was “becoming student centred -student orientated so all . . . that you create has got to be stuff that they are interested in” (BTran-416). His strategy was to write and work through learning activities for his various classes. Alan trialled the material in collaboration with his students and modified the instructions in response to their feedback- “the most effective way to create those sorts of instructions is to come up with a concept and then actually do it myself and write the instructions as I go every single step and then to trial them and then to go back and fix them because they’d always need fixing.” (BTran-124). Alan thought having his own students work through the online learning material helped him to improve the sequence of steps in the instructions. He enacted a typical interaction with students to illustrate this process

beginning with “the best way with it is where a kid sticks up their hand and says ‘what do we do now? . . . this isn’t what’s on the notes . . . this isn’t what you said’ and you look at it and you think: how did you get there? . . . and so then you need to deduce what you’ve done wrong. And to you as a teacher what you have done wrong -they [the students] haven’t done anything wrong they follow the instructions and if there’s a gap in the instructions, then whose fault is that?”(BTran-136). He also believed this process provided a very effective learning activity for the students. “So it comes down to getting them confident in that what they’re actually working with . . . as well” (BTran-141).

For Alan the online exercises he created and developed were effective because the steps were small discrete learning experiences; each step was simple and each step incorporated an active learning experience. “I don’t overwhelm them with detail. You chunk it into small pieces and one of the aspects of chunking it is you read - you do and - you do immediately”(BTran-109).

4.2.2 Theoretical Framework

Alan’s responses were then read for examples of characteristics of observable features expected to be evidenced in learning environments or instructional material based on each one of three major learning theories identified by Ally (2004). The results are presented under the headings of these learning theories: Behaviourist; Cognitive and Constructivist.

4.2.2.1 Behaviourist

Behaviourist Learning Theory discussed in Chapter 2 Review of Literature is identified by Ally (2004) as producing “observable behaviour that indicates whether or not the learner has learned something” (p. 7). As noted earlier Alan was interested in the design of instructional material and throughout the initial interview provided detailed descriptions of various structures he had observed, developed and used. Alan wanted the online tutorials he created to simulate a one-to-one teaching situation “You want to be sitting with them you want to facilitate the learning experiences But and here’s the quid pro quo -learning experiences happen best in a structured environment” (BTran-654). Alan’s comments on features of online instructional materials using various Bryce and Photoshop software are listed under categories that Ally associated with Behaviourist theory and are also presented in Table 4.7 below. The tutorials at <http://psd.tutplus/tutorials.com> mentioned by Alan were examined and examples to support Alan’s descriptions also presented in Table 4.7.

Table 4.7 Alan: Features of Behaviourist Theory

Features of Behaviourist Theory Ally(2004) expected in online instructional material	Descriptions of the structure of online learning activities taken from the transcript of interview, field notes and examples from “Create a Sleek and Clean MP3 Player Interface” www.tutplus.com/tutorials
<p>“Learners are informed of learning expectations so they can assess their own performance” (p. 7).</p>	<p>“Just tell them you’re trying to make them think and that’s enough to make them think ‘oh yes this is supposed to be a higher order’ . . . something I’m aiming for” (BTran-351).</p> <p>Example: Introduction “Create a Sleek and Clean MP3 Player Interface . . . [image of] Final Product What You’ll Be Creating” (p.1). www.tutplus.com/tutorials</p> <p>“Well you’re learning it because . . . you need to learn how to learn software” (BTran-356).</p>
<p>“Testing is integrated into learning experience to ascertain achievement and provide feedback” (p. 7).</p>	<p>“Sometimes you need to make that learning explicit sometimes you need them first to take it in and become used to it and then you go draw it out and find out what it is that has been learned” (BTran-659).</p> <p>Example: “Step 12 From the option bar you need to select the best Anti-aliasing methods to prevent blurry appearance. I can’t say which one is better because it’s different for each font type and size. You need to experiment with each setting” (p. 8). www.tutplus.com/tutorials</p>
<p>“Material is sequenced usually from simple to complex, to promote learning” (p. 7).</p>	<p>“My technique . . . is involved in creating an initial set of instructions to lead them through an example . . . with fairly detailed instructions, then to give them another task with a lot less instructions . . . same sort of task and then to give them another task where all they’ve got is the bald outline all of the task” (BTran-88).</p> <p>Example: “Step 38 Duplicate layer shape we have just created and add these layer styles” (p.22). www.tutplus.com/tutorials</p>
<p>“Feedback allows learners to monitor their own progress and determine an action” (p. 7).</p>	<p>“I’d give them the task, I’d give them the instruction material, get them to do the task associated with it . . . and then they knew all of that material was leading to the assignment so they would do it then” (BTran-117).</p> <p>Example: “Step 57 These layer styles are not enough to get a convincing 3D appearance . . . we need to add some . . . line detail See the picture below for reference. Step 58 Let’s step back and see the result in 100% view” (p. 39). www.tutplus.com/tutorials</p>

The example of the introductory page to “Create a Sleek and Clean MP3 Player Interface” is shown in Figure 4.3 below. This tutorial comprises 58 closely sequenced steps where learners are lead through a set of computer graphics techniques. The techniques increase in complexity and are reinforced by repetition from one step to the next. At each stage in the development of the MP3 Player Interface learners are encouraged to stop and reflect on their progress. They are

asked to observe some special feature and in some instances experiment with settings that suit the computer they are using.

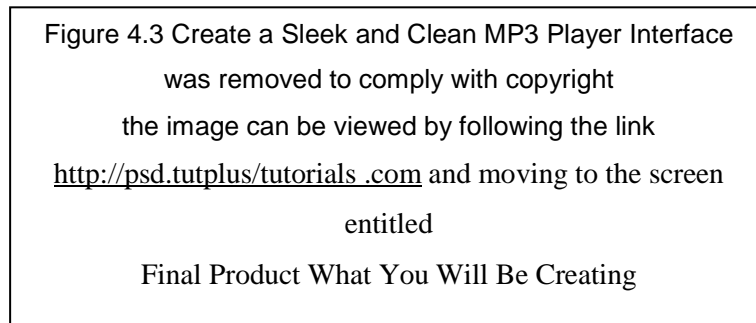


Figure 4.3 Create a Sleek and Clean MP3 Player Interface

The tutorials “Create a Sleek and Clean MP3 Player Interface” found at <http://psd.tutplus/tutorials.com> was further examined for evidence of other components of Behaviourist learning theory.

4.2.2.1.1 Respondent Learning

Respondent learning, the first sub-category of Behaviourist Learning Theory is associated with Ivan Pavlov’s techniques of conditioned response. From the Review of Literature Chapter 2, Burton, Moore and Magliaro (2004) state this is where learners are gradually trained to respond to what is initially a neutral stimulus such as a whistle. In his responses Alan spoke of negative influences which reduced students’ capacity to learn even in well structured learning environments. He called these influences ‘blockers’ and believed that reducing their influence was as important as producing positive stimulus. “. . . the whole thing about learning is you’re often not so much associated with what are the success points . . . you’ve got to remove the blockers”(BTran-608). While this might suggest Alan was referring to negative stimulus in the online instructional material, in a later clarification it became clear that Alan was speaking about negative socio- economic factors that influence attitudes to learning in general and diminish enthusiasm for and the habit of following instructional materials. “- ‘To Sir With Love’ didn’t really touch on the educational aspects. But if you read the book and watch the movie . . . you’ve got a whole set of things . . . - in fact what they dealt with in the book were blockers.” (BTran-621). Respondent Learning as described by Ally (2004) was not evidenced in material referred to by Alan.

4.2.2.1.2 Operant Conditioning

The second sub-category of Behaviourist learning theory outlined in the Review of Literature Chapter 2 is Operant Conditioning where a tutorial would have an automated sequence of cues, operands and consequences in line with a stated educational goal. From Burton, Moore and Magliaro (2004) the consequences of a learning activity would be electronically monitored and the cues repeated in a feedback loop known as ‘schedules of reinforcement’ (p. 11). The tutorials Alan described were not automated in this way.

The design of tutorials used by Alan did however evidence features associated with three sub-procedures of the ‘cue-operand-consequence’ sequence. These are identified by Burton, Moore and Magliaro (2004) in the Review of Literature as complex learning, problem solving and transfer. Examples include the contiguous chained behaviours which develop complex learning, the trial and error experiences which require learners to make tactical adjustments to solve problems and of transfer where identical behaviours are replicated “from [one] task . . . to a new task that has similar elements” (p. 12). The examples are presented in Table 4.8 below.

Alan believed that asking students to repeat tasks in a variety of slightly altered contexts helped learners retain what they had learned and also provided motivation to keep learning-“Yes you also cement it in and it’s locked in, you . . . retain it more and it becomes . . . something that you use because if you’re learning something at ‘the point of need to know’ you’re much more likely to use it again.”(BTran-468).

Table 4.8 Alan: The antecedents (cues or signals), Operands Consequences Sequence

Features of Operant Conditioning Burton, Moore and Magliaro (2004) expected in instructional material	Features in the Online Tutorial Create a Post-Apocalyptic Matte Painting found at http://psd.tutplus/tutorials.com Observations by Alan
<p>Complex Learning: “chained behaviours . . . through practice and contiguity, the consequence [of one learning step] takes on a dual role and becomes the stimulus [for the next step] mechanism as relying on the learner building associations based on the simplest unit they have learned in an environment which provides contiguity and utilizes repetition” (p.12).</p>	<p>“Yes, so they get to do it and then they get to do it again and the third time they just have to fulfil the goals of the task. By that stage some of them become quite creative and some of them really struggle to . . . but to build up their skills that way, where they actually have to think” (BTran-94).</p> <p>“Step 2 As you can see we’ve got a problem. At the moment this photograph was made, two people who wanted to ruin our image took a seat on the wooden seats on the bottom of the image. Obviously, we want to remove the people. To do this we are going to use one of Photoshop’s amazing features, the content aware fill option.” (p.4). http://psd.tutplus/tutorials.com.</p>
<p>Problem Solving: “tactical readjustment to changes in the environment . . . [a] trial and error experience the capacity to . . . controlling the sequence of material, monitoring the student’s progress and providing appropriate help results in the learner’s ability to generalize (respond the same way to similar stimuli) and discriminate (respond differently to varied stimuli)” (p. 12).</p>	<p>“I believe in scientific method -concrete to abstract. - learning activities that lead to the question “why is it so?” Activities that lead them to try to understand what makes the concrete hang together. If they don’t learn to pull the [abstract] ideas out -then they’re always dependent on other people to show them the links” (BNotes-4).</p> <p>“Step 11 . . . To make light rays we need to extract the brightest part of the clouds . . . A good tip is to make some duplicates of the rays and stretch them so that you are really getting the feeling of volumetric lighting.” (p.12) http://psd.tutplus/tutorials.com.</p>
<p>Transfer :</p>	<p>“Teach them how to learn it themselves [so that] they can transfer it to other similar situations” (BNotes-2).</p> <p>“You see you teach them a lot of things and give them a lot of exemplars . . . [and] give them something subtly different. . . or completely different . . .” (BTran-324).</p> <p>“Step 12 . . . to spice the image up a little bit you can add one or more grunge texture layers and some more destructive elements . . . Just erase the parts you don’t want . . . (p. 13). http://psd.tutplus/tutorials.com.</p>

Figure 4.4 below is the screenshot which accompanies the Conclusion of the “Create a Post-Apocalyptic Matte Painting” tutorial at <http://psd.tutplus/tutorials.com>. The text includes an explanation of the theoretical underpinnings of the final touches.

“This is a classical trick is[sic] matte painting composing because is blends everything together really well and it gives a more natural feeling because the same amount of noise is applied to everything . . . The final image is below. Thanks for reading and I hope you learned something new!” (p.14).

Figure 4.4 Create a Post-Apocalyptic Matte Painting
has been removed to comply with copyright.
The image can be viewed by following the link
www.bryce.com/tutorial
and moving to page 14 .

Figure 4.4 Create a Post-Apocalyptic Matte Painting

These examples of online learning activities were later cited by Alan in clarification discussions about the way online tutorials have been developed. Alan observed that software is developed commercially following what has become known as the Microsoft ‘beta’ process. In the ‘beta’ process, software developers release a product and then rely on feedback from the users of the software to identify problems which are then solved by Microsoft, which provides repair kits known as ‘service packs’. This is how tutorials are developed and the process fits well with the Problem Solving component of the Operant Conditioning subcategory of Behaviourist theory identified by Burton, Moore and Magliaro (2004).

4.2.2.1.3 Observational Learning

The third sub-category of Behaviourist Learning Theory Observational learning is characterised as *vicarious* learning by Burton, Moore and Magliaro (2004). It derives from Social Learning Theory where learners observe “other people’s behaviour and its consequences for them” (p. 12). Alan made a similar observation when he declared “Yes. Yes and that’s part of that teaching them . . . modelling [to] them to be what you want, what you want them to do well.” (BTran-226). Table 4.9 below presents evidence found in Alan’s references to learning materials that exhibit the components of observational learning which are: attention; retention; motor reproduction and motivation.

Table 4.9 Alan: Components of Observational Learning

Features of Observational Learning expected in instructional material Burton, Moore and Magliaro (2004)	Features of Observational learning described by Alan
<p><u>Attention</u>: observers' sensory capacity (perceptual set)</p> <p>"Learners should be told why they should take a lesson so that they can attend to the information throughout the lesson . . .links to both simpler and more complex material can be used to accommodate learners at different knowledge levels" (p. 11).</p>	<p>"Just tell them you're trying to make them think and that's enough to make them think 'oh yes this is supposed to be a higher order' . . . something I'm aiming for" (BTran-351).</p>
<p><u>Retention</u> : response patterns and how they are represented in memory in symbolic form</p> <p>"Questions presented before the lesson facilitate the recall of existing knowledge and motivate them [learners] to find additional resources . . ." (p. 12).</p>	<p>"You can get it more easily and for those who are actually interested- having learned the basics in the lower end product -to step up to the high end . . . if they are going to make that effort to step up to the high end they already have needs they want to fulfil . . . and therefore will find the answers themselves "(BTran-451).</p>
<p><u>Motor reproduction</u>: organisation of responses on the basis of feedback</p> <p>"Information should be chunked to prevent overload in working memory" (p. 12).</p>	<p>"You chunk it into small pieces and one of the aspects of chunking it is you read - you do and - you do immediately" (BTran-110).</p>
<p><u>Motivation</u>: evaluative judgments that learners make about what they have learned and how it will affect their performance.</p> <p>"strategies that require learners to apply, analyze, synthesize and evaluate promote higher level learning" (p. 12).</p>	<p>"I'd give them the task, I'd give them the instruction material, get them to do the task associated with it . . . and then they knew all of that material was leading to the assignment so they would do it then."(BTran-117).</p>

From the Review of Literature these components of observational learning are also closely related to elements identified in the theory of Symbolic Modelling, where learning results from watching live or filmed performance or descriptions of performance and of the consequences. Symbolic Modelling is discussed in greater detail in section 4.6.2.3 where McLuhan's (1967) concept of electronic media as an extension of the human nervous system is considered under the heading of a Constructivist Learning Theory.

4.2.2.1.4 Methodological Behaviourism

The fourth sub-category of Behaviourist Learning Theory is called Methodological Behaviourism. Examples in computing include: online question and answer (Q and A) tutorials, the management of complex conferencing and the use of automated administrative procedures. Alan encouraged his students to utilize all types of automated help. "What I do . . . I'm starting to teach them how to use 'Help' as well because a lot of 'Help' isn't very good in terms of its clarity

but by year ten they are usually able to start figuring it out”(BTran-227). However, he did not utilize the monitoring features available with these tutorials. His responses suggested he opposed the concept of a ‘teacherless’ automated instruction: “most people who do those experiments don’t actually know why they’re doing it. They’re just following the instructions without any comprehension” (BTran-304). Table 4.10 below presents examples of what the researcher believes is Alan’s adaptation of Methodological Behaviourist learning theory.

Table 4.10 Alan: Components of Methodological Behaviourism

Features of Methodological Behaviourism Burton, Moore and Magliaro (2004) expected in instructional material	Observed Features in Artifacts examined by the researcher
Automated instruction: Training videos and audio visual instructional material computers provide control of the sequence of material.	“And do them a number of times. And in the long run there is the move to doing more simulation . . . and we see . . . on the computer the great thing about it is you can go back over it and over it and over it and over it” (BTran-310).
Online Q and A: Responses observed and analyzed. Acting as tutors, and they can be programmed to respond to learners’ questions.	“Yes and to understand how the help files . . . work and so by doing that- that makes for a much better resource for them as well but it ain’t easy to get them to do it”(BTran-238).
Automated tutors: Email and video conferencing, computers monitored learners and determined when they needed help, selected the type of help and used the Internet provide appropriate help.	<p>“I’ve got my Year twelve using a MSDN online and they also use the built-in ‘Help’ files” (BTran-238).</p> <p>“I’ve got them using Flash ‘Help’. That’s built into the software as well as online and the year twelve kids know how to use Google to bring up things that might help” (BTran-238).</p>

In summary the instructional material and learning environments described by Alan exhibit many features associated with Behaviourist learning theory, especially those which promote complex learning, problem solving and the capacity to transfer learned skills and knowledge to new situations. While he makes full use of computer technology and the Internet he is clearly sceptical of automated monitoring and believes passionately in experiential learning and the need to develop in students a love of learning. In the next section Alan’s responses are examined for examples that fit with Cognitive Psychology Learning Theory.

4.2.2.2 Cognitive

Cognitive Psychology Learning Theory (CPLT) is identified by Ally (2004) as an internal learning process involving the use of memory, motivation, thinking and reflection. Alan makes a number of comments that clearly accord with CPLT. Examples to support this statement are taken from his comments and the Bryce website to which he referred and presented in Table 4.11 below.

Table 4.11 Alan: Features of CPLT Observed in Online Learning Material

Features Ally (2004) expected in online learning material based on the CPLT	Features observed in descriptions of instructional material and artifacts collected from Alan
information carefully coloured, placed and paced to assist them to perceive and transfer it to working memory.	‘Step 2 Creating the grass around the path’ ‘Now for the terrain there should be six buttons (sic) to the right’ These are circled and enumerated in bright red. This technique is used consistently throughout the Bryce tutorials.
Information . . . grouped into generalized categories using information maps.	“Most people learn better ‘concrete first then abstract’ Again it’s back to Piaget” (BTran-663).
. . . help learners construct a link between information in long term memory and new information.	“directions . . . all working at different paces . . . but you need to make it explicit that –that’s OK because we’re not all going for the same goal. But the reality is we are . . . we all have to learn how to do . . . how to teach ourselves” (BTran-794).
. . . require learners to apply, analyse, synthesize and evaluate information.	“Yes so it’ll all be about knowing your own learning style . . . if you want to improve taking on tasks that will help you to work on that as well . . . take on things that are task orientated but it’s got to be set up for someone who wants to improve their task orientation” (BTran-811).
. . . materials . . . to suit various learning styles.	“You come back and re-visit the material –‘this didn’t work so we are going to do it again . . . differently’. And when it works the second time they say ‘Why didn’t you do that the first time? . . . because I didn’t think of it’” (BTran-795).
Support materials . . . appropriate to the learners’ preferred style.	“ . . . 29 students all working on different stuff . . . you need to maintain control of that classroom without running it- running by keeping people on task . . . or similar tasks.” (BTran-788).
Learning material . . . constructed to motivate learners.	“You learn by doing and evaluating what you have done . . . reflected on what I had achieved and hadn’t achieved during the day . . . when I can see things succeeding . . . that sort of self reflective evaluation becomes very valuable. When you live five minutes from where you work you’ve got to make time for that outside of your travel time. It’s by doing that sort of thing . . . you improve what you’re doing. And the kids do respond well to your re-focusing onto making them learn” (BTran-772).

In summary, the instructional material and learning environments described by Alan exhibit features Ally (2004) expected to be found in online learning material based on CPLT. Learning strategies are developed to suit various learning styles. Colour is used in the tutorials to group information into generalized categories and assists memory. An example illustrated by Figure 4.5 below is taken from the Bryce tutorials and shows colour being used to circle important features on a diagram in much the same way as an instructor would use a red highlighting pen in a classroom.

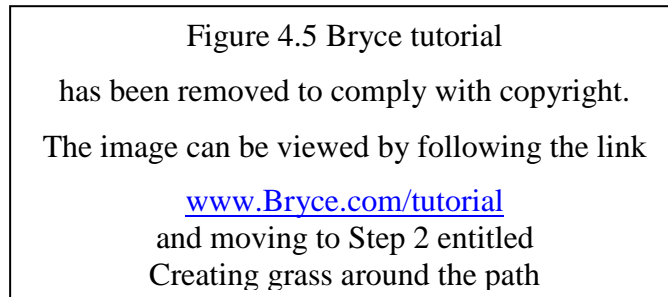


Figure 4.5 Bryce tutorial

It can be argued that this format helps learners create links between long term memory and new information. Alan's responses also clearly indicate that in selecting and developing his repertoire of online learning activities he is always conscious of the role motivation and enthusiasm play in what he calls 'deep learning'. This is discussed more fully in section 4.2.3 Education and the Internet and Chapter 5 Cross Case Analysis.

In the next section Alan's description of online learning environments and his comments were examined for features associated with Constructivist Learning Theory.

4.2.2.3 Constructivist

Constructivist Learning Theory contends that "learners learn best when they can contextualize what they learn for immediate application and when they learn to acquire personal meaning" (p. 7). In a general observation Alan stated "This . . . standing in the classroom is a mistake. As a teacher you shouldn't be standing in the classroom because as a teacher you're dominating Sometimes you need to make that learning explicit sometimes you need them first to take it in and become used to it and then you go draw it out and find out what it is that has been learned" (BTran-659). Table 4.12 below presents examples from Alan's explanations that would be expected to be found in a constructivist learning environment. They include examples of Alan's descriptions of tutorials written by students for other students.

Table 4.12 Alan: Features of Constructivist Observed in Online Learning Material

Features Ally (2004) expected in a learning Environment based on Constructivist Learning Theory	Features found in Alan's descriptions of the online Learning environment of www.Bryce.com
Strategies to make learning an active process.	"[the student] wrote a tute and he trialled it on the rest of the class- he rewrote the tute After the third trial he was more into the swing of it he ended up writing five . . . which took us up to a reasonable level . . ." (BTran-767).
Opportunities for learners to construct their own knowledge.	"So in time I'll get WIKIs setup where kids can actually create their knowledge in there . . ." (BTran-686).
An environment that encourages collaborative learning is promoted.	". . . if they need help I use the 'ask three before you ask me' and then with the 'ask three before you ask me' with some kids I ask . . . Who did you ask? And then I'll say to the kids that they've asked So how come you didn't answer the question? . . . If you didn't know why aren't you up here with the person trying to find the answer?" (BTran-189).

Alan was developing plans for creating a WIKI with a group of students. "I'm hoping later this year to have an experimental one [WIKI] up . . ." (BTran-711). He was taking it slowly because he wanted to get it right. "I'll refine [it] over a number of years. I don't expect it to be a serious learning tool inside eighteen months . . ." (BTran-716). His major concern was with the quality of the information posted on the WIKI. He stated that "the learning will be occurring in the 'learning how to use it' . . . And control it . . . because they'll be learning about the problems with it as well" (BTran-721).

Alan believed a Constructivist learning environment introduced a new type of social responsibility for teachers. He used the process of setting up a WIKI to clarify the problems he envisaged. "I'll have two sorts [WIKIs]. One that's more open and one that's restricted to registered users. . . . The registered users' one becomes less spontaneous but it becomes more effective hopefully. The wide open one you have to have people in there to help you stop abuse that comes in unnoticed. So you need people who are prepared to be alert" (BTran-724).

In the next section, the artifacts, observations and comments by Alan are examined for influences brought by the Internet.

4.2.3 Education and the Internet

For Alan the Internet provides access to up-to-date and relevant learning materials, communication with experts in the field at the time it's needed and the ability to provide feedback and allows him to direct learners to materials appropriate to VCE learning outcomes.

i Access to up-to-date and appropriate learning materials.

Alan's descriptions of his classroom practice and management of online learning material suggest he uses the Internet in the ways Ally (2004) describes. The Internet offers Alan the opportunities to enhance his natural teaching style. Google for example, provides instant access to a broad range of learning activities to which students can be referred according to their preferred learning style. In particular Alan's belief that "you learn something at the point that you need to know it", (BTran-464) is facilitated by access to the Internet and his ability to direct students to appropriate material.

ii Access to experts in the field and quality feedback at the time it's needed

While for Alan the Internet's resources include Experts Systems and Decision Support programs that can be used to check facts and rank the options available for more straight forward student assignments, it also offers a global environment where instructional material can be trialled, and then modified when feedback is evaluated.

Alan believes the 'beta' process established by Microsoft and described in section 4.2.2.1.2 provides a process which legitimizes the trial and error process he models in problem solving activities, and is as important in the learning process, as the WIKI procedures and protocols for editing he hoped to develop with his students in the following year.

4.3 Case Margot

Margot was the Information Communication Technology (ICT) manager at a private religious college in Melbourne Victoria. At the same time she had extensive involvement in the development of online and printed resource material for the Victorian Curriculum and Assessment authority (VCAA) and the Victorian Information Technology Teachers' Association (VITTA) www.VITTA.com.au . She had been teaching Year 12 VCE Information Technology classes in the previous two years but at the time of the first interview (CInt-00-00), student numbers were too low for the school to timetable a class. As a background for the interview she recounted her early teaching experience in the poorer neighbourhoods of Chicago. In the early 1970s American university graduates in subjects other than education could join a Teaching Corps and receive a Masters Degree in Education after they completed two years of closely supervised teaching practice in a disadvantaged community. Margot had joined the Teaching Corps and specialised in urban education where she and others in a team had developed many strategies to provide instruction for communities unable to purchase textbooks or access other basic learning resources.

Throughout the interview, and in follow-up conversations, Margot referred to examples of interactive learning activities conducted using all manner of real-time communication technologies to illustrate many of her ideas. Themes discussed in this section were derived from Margot's comments, observations and descriptions of online learning.

In the next section the transcript of interview and artifacts collected from Margot, together with observations of the learning environment she had created were examined for emergent themes.

4.3.1 Emergent Themes

When the data collected from Margot were examined three themes emerged. The first was the installation of MOODLE software on the school's network and her role in providing support for teachers who wanted to use it. The second was a collaboration with enthusiastic history and religious studies teachers to incorporate forums and WIKIs into their teaching practices. The third was her own use of chat rooms and forums to provide students with an online space where class learning exercises, homework and assignments could be discussed in real time. Throughout the interview these three areas of interest served as a framework for many of her responses to the eight initial open-ended questions.

i First emergent theme: the school's need for a reliable computer network.

This theme derived from teachers', students' and parents' need for a reliable computer network which they could all use for curriculum activities. Margot had contracted a private computer networking company to set up a MOODLE website for the school [school name].MOODLE.cc.com.au. "They set it up for me . . . they set up their own little domain and we pay them to host our MOODLE . . ." (CTran-227). Margot explained that while the school used text books and students could afford to buy whatever titles were recommended, the teachers mostly wrote their own notes. "So, we do use textbooks here, but teachers are encouraged not to rely on them. You are encouraged to write your own and hence the online MOODLE stuff has been the best thing . . . it's a nice repository . . . [for] files to have them online, and to have them available" (CTran-218). Margot had to familiarize herself with the MOODLE system before she provided instructions for the rest of the staff. "So I set up MOODLE . . . and I experimented with my [Information] Systems class" (CTran-218). Once she had set up her own notes and mastered the basics of the MOODLE system she began to show other teachers how the system worked "I said to the History teacher, 'This is what I'm doing. I kind of like it,' and he went, 'Oh my God! How wonderful is that?' " (CTrans-250).

ii Second emergent theme: working with teachers who embraced the new technology.

At the time of the interview the school's MOODLE system had been upgraded and she believed it had been made much easier for the teachers to use. The librarian in particular had made full use of the file storage facilities and forums it provided, "R in the primary library really took MOODLE and she used it, . . . the kids made comments and they did their journals. She had all kinds of information for them, assignments and stuff, and she taught her library skills with the hands-on stuff, and she also used the online stuff "(CTran-324). Margot was however disappointed that students and teachers were unable to log into the school's network and utilize all its features or to access all the electronic files that she would like. She believed the school's technicians were resisting her requests to extend MOODLE's availability. " We wanted . . . When a kid logs on from this school, they can automatically log on to that server . . . and it is safe and it is secure. Many other schools and teachers have said there is not a problem . . . our guys [the technicians] wouldn't do it . . . they are worked to the bone " (CTran-324). She needed another way, in the first instance, to extend access to her notes to other students. To find the solution Margot went outside the school and used her role as a curriculum support writer for the teachers' association VITTA [Victorian Information Technology Teachers' Association]. "I have to take a . . . step back and find another way. So, I found my other way using the VITTA one [website]."

In the long run she achieved what she wanted for the school's network but not without the enthusiastic teachers who had been first to take up the technology having to do a lot of unnecessary tedious work, "so we got it done . . . R in the library had to type in all of the Grade 5s and all the Grade 6s by hand, because that uploading of the stuff in MOODLE didn't work" (CTran-324).

iii *Third emergent theme: real-time communication with forums chat rooms and WIKIs*

Margot had been a longtime ham radio operator and was very experienced in distance communication conducted in real time. Her personal website address incorporated her long held ham radio identity, ". . . that's my ham radio call sign" (CTran-247). In 1995, her enthusiasm for radio communication, led her to set up a communication project with the Russian cosmonauts living on the space station. At first the project involved only radio communication but it quickly developed to an early use of a "radio modem . . . for . . . packet communication and the transfer of voice files" (CTran-247). Margot had organised a group of students to prepare questions in the areas of Physics and Biology. One student for example, asked "Do you faint in space?" Margot spoke basic Russian and was able to translate the questions. By arrangement with the Russian authorities the cosmonauts received the questions in Russian and prepared responses in English which they could answer in the real-time communication with the students. She observed how person-to-person communication could enhance understanding when she recalled that one cosmonaut had told the students he was very nervous. The project was reported in Time magazine and Margot received an award from the Wireless Institute of Australia (WIA).

In summary three broad themes emerged from Margot's responses to questions and observations of the online learning environments. First, school communities want the curriculum available via a reliable and secure network. Secondly, some teachers take up the technology with enthusiasm. Thirdly, the Internet and its forums chat rooms and WIKIs are just the latest advance in technology that enable real-time communication.

In the next section theoretical considerations derived from major learning theories discussed in Chapter 2 Review of Literature were used to examine Margot's responses, the artifacts collected, samples of instructional material provided online to teachers of VCE Information Technology and field notes made by the researcher.

4.3.2 Theoretical Framework

Margot's responses were examined for examples of characteristics of observable features expected to be found in learning environments or instructional material based on one of three major learning theories identified by Ally (2004). The results are presented under the headings of these learning theories: Behaviourist; Cognitive and Constructivist.

4.3.2.1 Behaviourist

Behaviourist theory discussed in Chapter 2 Review of Literature is identified by Ally (2004) as producing "observable behaviour that indicates whether or not the learner has learned something" (p. 7). Features that Ally associated with Behaviourist theory were used to examine assessment tasks Margot had written as support material for teachers. These were found in the *VCE Assessment Handbook Information Technology 2007-2010* VCAA (2006b): "I wrote the Assessment Handbook" (CTrans-428), and she had created many of the exemplar activities published on the VCAA website. The examples of online instructional materials presented in Table 4.13 below are taken from the *VCE Assessment Handbook Information Technology 2007-2010*.

Table 4.13 Margot: Features of Behaviourist Theory

Features of Behaviourist Theory Ally (2004) expected in online instructional material	Online Learning Assessment Activity Advice VCE Assessment Handbook Information Technology 2007-2010 VCAA (2006b)
"Learners are informed of learning expectations so they can assess their own performance" (p. 7).	"Schools must provide students with clear written details of both the VCAA rules . . . specify the work that a student must do to . . . for Graded Assessment" (p. 4).
"Testing is integrated into learning experience to ascertain achievement and provide feedback" (p. 7).	"It is important that students know what is expected of them in an assessment task. This allows them to understand during the teaching and learning stage what they are expected to know" (p. 53).
"Material is sequenced usually from simple to complex, to promote learning" (p. 7).	"The teacher plans a sequence of teaching and learning activities that will develop pre-task knowledge and skills . . . (p.54)".
"Feedback allows learners to monitor their own progress and determine an action" (p. 7).	"Feedback provides students with important advice about which aspect . . . of knowledge they need to learn and in which key skills they need more practice" (p. 51).

The teacher advice found in the *VCE Assessment Handbook Information Technology 2007-2010* VCAA (2006b) was examined for evidence of the four variations of Behaviourist Theory identified by Burton, Moore and Magliaro (2004) as Respondent learning, Operant conditioning, Observational learning and Methodological behaviourism. Examples of Operant conditioning and

Observational learning were found in data collected from Margot and these are presented in Tables 4.14 and. 4.15

4.3.2.1.1 Operant Conditioning

The second sub-category of Behaviourist learning theory is outlined in the Review of Literature Chapter 2 as Operant conditioning. A tutorial reflecting this theory would have an automated sequence of cues, operands and consequences in line with a stated educational goal. From Burton, Moore and Magliaro (2004) the consequences of a learning activity would be monitored (observed) and the cues repeated in a feedback loop known as ‘schedules of reinforcement’ (p. 11). The sample approaches to VCE course work material found in the *VCE Assessment Handbook Information Technology (2007-2010)* VCAA (2006b) showed no evidence of automated sequences of cues/signals-operands-consequences and none of the type automated educator control described. The material did however show strong evidence of three associated sub-procedures of the ‘cue-operand-consequence’ sequence. These are identified by Burton, Moore and Magliaro (2004) in the Review of Literature as complex learning, problem solving and transfer. The examples of advice to teachers for creating online instructional materials are presented in Table 4.14 below.

Table 4.14 Margot: The Antecedents (cues or signals), Operands Consequences Sequence

Features of Operant Conditioning Burton, Moore and Magliaro (2004 expected in instructional material)	Features in the Online learning assessment activity created by Margot Information Technology VCE Study Design VCAA (2006a)
Complex Learning: “chained behaviours . . . through practice and contiguity, the consequence [of one learning step] takes on a dual role and becomes the stimulus [for the next step] mechanism as relying on the learner building associations based on the simplest unit they have learned in an environment which provides contiguity and utilizes repetition” (p. 12).	“Create a guide for individual users wishing to establish a permanent connection to the Internet for the first time outlining software they should install, procedures they should follow and issues they should be aware of” (p. 83).
Problem Solving: “tactical readjustment to changes in the environment . . . [a] trial and error experience . . . controlling the sequence of material, monitoring the student’s progress and providing appropriate help results in the learners ability to generalize (respond the same way to similar stimuli) and discriminate (respond differently to varied stimuli)” (p. 12).	In the case of a networked information system set up for a medical centre- “Write an algorithm to represent the prototype design” (p. 82).
Transfer : “involves the replication of identical behaviours from [one] task . . . to a new task that has similar elements” discriminate and to generalize as inversely related and as central in the processes that enable learning to be adapted and transferred to other environments” (p. 12).	In the case of a networked information system set up for a medical centre- “compare and contrast software designed to the same design specifications . . . test software to enable a medical practice to store data on its patients” (p. 82).

4.3.2.1.2 Observational Learning

The third sub-category of Behaviourist Learning Theory is Observational learning. It is based on the idea that new behaviour can be learned by observing the behaviour of others. Burton, Moore and Magliaro (2004) note this is also known as *vicarious* learning and derives from Social Learning Theory where learners observe “other people’s behaviour and its consequences for them” (p. 12). Margot’s descriptions of student-student and student-teacher interactions while collaborating in forums and building WIKIs evidenced observational learning as did her references to learning materials. Examples are presented in Table 4.15 below to illustrate the components of observational learning: attention, retention, motor reproduction and motivation.

Table 4.15 Margot: Components of Observational Learning

Features of Observational Learning Burton, Moore and Magliaro (2004) expected in instructional material	Features of Observational Learning in Margot’s Descriptions of Online Interactions with Students
<u>Attention</u> observers sensory capacity (perceptual set) . . . “Learners should be told why they should take a lesson so that they can attend to the information throughout the lesson” (p. 11).	Margot speaking to a teacher about creating a WIKI. “And I went through the whole thing and she didn’t understand a word. I said, “But the kids know what it is and they want one.” I said, “Okay, I’ve set you up one,. So, I got the kids in class and I showed them it, and they immediately understood” (CTran-498).
<u>Retention</u> “response patterns and how they are represented in memory in symbolic form” (p. 12).	Margot speaking to a student “I said, “Here, you’re on the controls. You’re the pilot” So he set up all the different things for forums, for all the different stuff that you have in Renaissance [History] and . . . I said, “Do you need some forums on this stuff? . . . And kids contributed” (CTran-501).
<u>Motor reproduction</u> “organisation of responses on the basis of feedback” (p. 12).	“Also, with the MOODLE thing I can see... okay, this girl, . . . she signed-up; she got onto it occasionally, but she didn’t stay on for very long, rarely contributed. I said to the teacher, “She’s not contributing; she’s not doing well at all. Because the teacher was so illiterate in computer stuff that I gave her that feedback, and she can go back to the class and talk to the kid about her learning So, we were able to focus in on the kid that way, and that was where that was wonderful.” (CTran507)
<u>Motivation</u> evaluative judgments that learners make about what they have learned and how it will affect their performance (p. 12)	Margot describing 24 hour communication with students “I had a look at those logs; 3 in the morning, 2 in the morning, and you don’t do that; you don’t have any idea until you look at those MOODLE logs just what is happening ” (CTran-505).

As noted in the Review of Literature Chapter 2, these components of observational learning are also closely related to elements identified in the theory of Symbolic Modelling, where learning results from watching live or filmed performance or descriptions of performance and of the

consequences. Symbolic Modelling is discussed in greater detail in Cross Case Analysis Chapter 5 where McLuhan's (1967) concept of electronic media as an extension of the human nervous system is considered under the heading of a Constructivist Learning Theory.

In summary the instructional material and learning environments described and praised by Margot do exhibit features associated with Behaviourist Learning Theory, especially those which promote complex learning, problem solving and the capacity to transfer learned skills and knowledge to new situations. In the next section Cognitive Psychology Learning Theory (CPLT) was used to examine online learning material created by Margot.

4.3.2.2 Cognitive

Cognitive Psychology Learning Theory (CPLT) discussed in Chapter 2, Review of Literature is identified by Ally (2004) as internal learning process involving the use of memory, motivation, thinking and reflection. Their research suggests that learning material designed for online learning which utilised CPLT would exhibit identifiable features as listed in Table 4.16 below. The researcher examined online advice to teachers and sample activities Margot had created for the Information Technology Teachers' Association VITTA, and the *VCE Assessment Handbook Information Technology 2007-2010 VCAA (2006b)*. These both refer to the *Information Technology VCE Study Design VCAA (2006a)* and reflect layout used in that document.

Table 4.16 Margot: Features of CPLT Observed in Online Learning Material

Features Ally (2004) expected in online learning material based on the CPLT	Features Observed Advice for Teachers that reference the Information Technology VCE Study Design VCAA (2006a)
Information carefully coloured , placed and paced to assist them perceive and transfer it to working memory.	Headings are styled according to a house- styled hierarchy (p. 13).
Information . . . grouped into generalized categories using information maps	In examples of learning activities like categories are identified with like icons. (p. 73).
require learners to apply, analyse, synthesize and evaluate information	The Analysis stage of the prescribed Problem Solving Methodology (PSM) is defined (p. 50).Details of how teachers should present scenarios are provided in diagrams and text (p. 69).
materials . . . to suit various learning styles.	Mostly limited to text and visual literacy- but practical activities for example where students examine a website and comment on "standard resolution, loading time . . ." (p. 69).
Support materials . . . appropriate to the learner's preferred style	The scenario provides data in table format, supported by text and asks students to "Keep a visual record of decision-making and actions taken . . ." (p. 72).
Learning material . . . constructed to motivate learners.	Evident primarily in the allocation of marks per task. A typical example - [40 marks] is indicated for completing "Outcome 1" (p. 85).

The instructional material and learning environments recommended by Margot in the *VCE Assessment Handbook Information Technology 2007-2010* VCAA (2006b) are presented in online documents that are formatted according to the VCAA house style. The online documents examined used colour and font sizes to assist with navigation and diagrams and information maps as alternatives to text based communication.

4.3.2.3 Constructivist

Margot's development of online learning activities are strongly reflected in the components of Constructivist Learning Theory discussed in Chapter 2, Review of Literature. From Ally (2004) this theory contends that "learners learn best when they can contextualize what they learn for immediate application and when they learn to acquire personal meaning" (p. 7). Table 4.17 below presents examples from Margot's comments, advice to teachers and observations set out against features expected to be found in a constructivist learning environment.

Table 4.17 Margot: Features of Constructivist Observed in Descriptions of Online Learning Activities

Features Ally (2004) expected in a learning environment based on Constructivist Learning Theory	Features Margot's Descriptions of Online Forums, Chatrooms and WIKIs
Strategies to make learning an active process.	"When they first open the forums and their teaching systems, this one boy wrote, "The network outcome's coming up and I'm absolutely scared stiff. Do I know everything I need to know?" Now, it was the best thing ever because we only have five kids in the class; everybody contributed to that forum, even though we see the kid every day. They're on MSN to him all the time sending messages to him saying, "Don't forget you have to know this and . . this and this" (CTran-473).
Opportunities for learners to construct their own knowledge.	"When I marked those WIKIs, any information had to be paraphrased; all their own words and all the references had to be documented" (CTran-523).
An environment that encourages collaborative learning is promoted.	"Then I contributed . . . these are the study skills, key knowledge . . . We all worked it together; the forum thing was just the best ever" (CTran-471).

Margot's enthusiasm for online chats, forums and WIKIs provides many examples that fit well with components of the Constructivist Learning environment identified in Ally (2004). She explained how she used the chat site to help students who were grappling with computer coding activities late at night. "That's another thing . . . the chats are guarded all the time [Student] 'I can't do this code; this code doesn't work!' And I go, Oh, it's that line you know. You get stuff like that "(CTran-781).

Despite her long standing knowledge of computing techniques, Margot had never been personally interested in providing instructional material on CD ROMS. “I went straight to online [with forums and WIKIs]” (CTran-471). And she observed that instructional material prepared for an online learning environment had to be of a very high standard because students often used it unsupervised and because parents were inclined to check it. “Look, it takes three times longer to develop an online course, okay, than if I were just to scribble something up or run [off] at the mouth in class, on the fly. It takes three times longer and everything I prepare here, it has to be top class stuff because [of] the parents” (CTran-855). Irrespective of this attitude to online lessons, she had made it her responsibility to provide a reliable repository for online instructional material and curriculum documents that the school community could access at any time from any location. “We have this crabby- ass Intranet here where I can throw files on the system, but to have it in MOODLE made so much more sense, because it’s always there. But also the kids can access it although they can’t access it by the Net” (CTran-471).

Margot explained how constructing a WIKI provided an environment where her students could work collaboratively and learn to enhance the quality of the knowledge they were constructing. As a group the students assessed the quality of various websites, “and we went over what’s a good website and what’s a crap website. So, that had to be done or else nobody would trust their WIKI” (CTran-525). Margot stressed the importance of ensuring that the information each individual contributed to the group was reliable. “I said, “If you were working in a class and you’re doing Renaissance history, and you put some stuff up, the people in the class have to trust you” (CTran-527). Within the process of constructing a WIKI Margot’s students were taught how to cite sources. “So, you need to document where you’ve got everything, etcetera, etcetera . . . [because] no one’s going to use your WIKI if it’s balderdash” (CTran-532).

In summary Margot’s strategy to fulfil her role as an ICT manager was to facilitate access to a reliable up-to-date network and then work with those teachers who wanted to use computers in some way in their classrooms. For some teachers, this involved utilising the MOODLE platform to make their subject outlines and class notes available to the school community via the school’s network. For other teachers, it became developing collaborative learning practices with WIKIs, forums and chat rooms. Margot has always loved *real-time* communication technology, be it ham radio conversations, or online chats and forums. “There are people that hate forums; I love forums. I get a lot of information from forums and people are responding to threads and things . .

.” (CTran-423). In her own classroom Margot has built collaborative learning activities around communication technology.

In the next section 4.3.3 the artifacts, observations and comments by Margot were further examined for evidence of advantages identified by Ally (2004). For Ally, the Internet provides the access to up-to-date and relevant learning materials, communication with experts in the field and the ability to provide feedback and to direct learners to materials appropriate to learning outcomes.

4.3.3 Education and the Internet

For Margot, the Internet provided:

- i. extended/broadened opportunities for collaborative learning*
- ii. access to ongoing real-time discussion on topics of interest to her*
- iii. a chance to foster enthusiasm for collaborative learning among other teachers.*

Margot’s descriptions of online learning activities which fitted well with Constructivist Learning theory were examined in relation to Piaget’s (1952) concluding remarks about the role of construction or invention in *The Origins of Intelligence in Children*. Piaget suggests “the problem of invention which in many respects constitutes the central problem of intelligence, does not, in the hypothesis of the schemata, require any special solution because the organization which assimilatory activity reveals is essentially construction and so is, in fact, invention, from the outset” (p. 418). For Piaget accommodation is “constructing relationships”, assimilation is “incorporating experience into the current universe” and intelligence is “the construction of relationships and not only identification” (p.418). This could describe Margot’s creative use of communication technologies in her teaching. in that it allows her to model her enthusiasm and capacity for invention directly to her students, encourage them to construct relationships and help them to incorporate their experience into the current universe. This notion is considered in a comparison of findings across all cases in Cross –case Findings, Chapter 5.

Finally, the researcher concludes that Margot sees her own learning as ongoing and her current use of the Internet as a stage in the process of finding new ways to communicate ideas. As a consequence Margot believes the Internet is “a tool, it’s a web tool, but it’s not the be all and end all” (CTran-533).

4.4 Case Bill

Bill is ICT manager at a secondary college in the outer Eastern suburbs of Melbourne in the state of Victoria. Bill is a highly respected authority in the IT teaching community. He is most widely known as the creator and moderator of 75 emailing lists on a government supported website. The website which Bill maintains allows teachers to set up emailing lists dedicated to particular areas of educational interest. At the time of the interview there were over five thousand subscribers across the lists and Bill estimated that there was “probably about 25% crossover, in other words, we probably have about 4000 unique subscribers” (WTran-136). He further estimated that a gigabyte of resources were downloaded and one thousand messages exchanged across all the lists. Teachers from a wide range of subject areas are invited to subscribe and discuss issues and share resources. Bill is also known as an accredited Cisco instructor. Cisco is the company that produces the routers and the software on which the Internet addressing structure relies. To offer Cisco courses, the instructors have to be accredited by the company and keep up-to-date with regular online professional development activities.

At the time of the interview Bill was teaching two Year 12 classes VCE Software Development and VET Information Technology. The students came from within his school and from other schools in the area. All instructional material for the Software Development course taught by Bill was available online and he conducted face-to-face classes for four hours one day a week.

Bill’s school needed a reliable computer network which teachers, students and parents could use to access curriculum documents. To meet these needs, Bill had initially set up the courses he taught with customized material on a platform he described as “a sort of web page based but not MOODLE [software used to manage online material]” (WTran-52). Then, five years previously he had decided to set up the school’s network using MOODLE because it had “lots of support for teachers . . . it’s free. It’s always evolving . . . it’s so widely accepted” (WTran-148). For his own classes the online instructional material included: the course outline; class exercises; associated homework and assessment tasks.

4.4.1 Emergent Themes

The data collected from Bill was examined following the qualitative strategy set out in the Methodology Chapter 3. Three main themes related to ICT emerged. The first was the decision to use MOODLE software to manage the delivery of online curriculum. The second was Bill’s aim to help teachers confidently utilize all the online facilities MOODLE and the Internet offer. The

third was to find ways to motivate students to work conscientiously through automated lessons.

(i) First Emergent Theme: The Decision to use MOODLE

The first emergent theme derived from the school's need for a reliable network for curriculum delivery. Bill set up the MOODLE software for the school's online classes. "I've built the MOODLE server myself" (WTran-83). He configured the school network and allocated usernames and passwords so that it was reliably "accessible from outside of the school" (WTran-50). Bill described MOODLE as the software "we use for our online classes" (WTran-51).

Bill found MOODLE useful in meeting the needs of the school. It offered a comprehensive suite of communication features for teachers to utilize. These included WIKIs, chat rooms and Blogs for interactive group discussions, or one-to-one instruction. Teachers could use MOODLE to post class notes and quizzes. Students could use MOODLE to submit assignments, read class notes and complete homework. Bill had automated the MOODLE software so that assessment tasks were "hidden or revealed depending on what they [students] need to do" (WTran-82).

(ii) Second Emergent Theme: Helping Teachers to Use Online Facilities

The second emergent theme derived from Bill's belief that most lessons, not just ICT, could be delivered by any teacher who had access to the appropriate content. In this belief he encouraged teachers to place their course outlines and associated learning activities on the school's internal network using the MOODLE software. After MOODLE had been set up Bill noticed that a large section of the school's teachers were reluctant to use any of the features offered by MOODLE. Bill stated, "Recently, because we didn't have enough staff using it . . . we built [an] Ultranet, where, with one log on, students can review their timetable"(WTran-82). He explained that students in what he called MOODLE-classes can "see what's due for that class by clicking on that class . . . in their subject . . . at that time of day and then download all their learning materials, and submit anything that has to be submitted, or any messages that are there from the teacher" (WTran-91). The researcher believes, from comments made by other teachers, that the amount of work involved in producing the learning material for each lesson may account for a reluctance to use MOODLE. A class teacher would have to develop, create, test and then update all the learning activities, homework exercises, assignments and assessment materials for these MOODLE-classes to function.

In the broader context of the ICT teaching community, Bill was concerned that many

inexperienced ICT Coordinators in schools had trouble setting up MOODLE. In response, Bill had organised a Professional Development activity in the previous year through the Victorian Information Technology Teachers Association (VITTA). He believed “any technician could do it [install MOODLE] reasonably quickly” (WTran-105) but thought some struggled because many schools expected their ICT Coordinators to “install it on some other platform, [and] there’s also the issue of accessibility from outside of the school” (WTran-91). He explained that the security issues associated with providing remote access to any school’s internal network meant that the person installing MOODLE probably needed “some technical knowledge” (WTran-112). To assist the ICT Coordinators, Bill had established an online MOODLE-help discussion list where “people can ask questions when they get bugs” (WTran-110). He believes that the resource sharing he had observed between teachers using the MOODLE-help discussion list, indicated that there was “. . . a lot of good support on MOODLE” (WTran-142).

Bill saw the MOODLE-help discussion list as the start of his plan to provide ongoing support for teachers. The outline for his plan included developing an online unit for inexperienced IT teachers “that might be, everything you need to know about . . . VCE IT networking” (WTran-445). He planned to include all of the networking concepts that he used in his Cisco classes such as online exams and an automated self-assessment procedure. Bill hoped that teachers who completed the unit would “know enough . . . to be able to have a sensible discussion, or to feel confident about writing an assessment task” (WTran-449). He believed that in an environment of constant technological change teachers need continuous high quality professional development to understand the technology, and said that “this isn’t [only] about rocking up and modifying a task” (WTran-453). It was his view that teachers needed ongoing access to Cisco or equivalent modified courses so that they can write tasks.

(iii) Third Emergent Theme: Motivating Students

The third emergent theme was engaging student interest. This derived from Bill’s observations of his students’ responses to online instructional material. As a general comment, he said that only a small number of students were keen learners and successfully used both the exercises he had created and other tutorials found on the Internet. These few students he classed as “exceptions . . . I mean there’s one student who’s brilliant in Flash and ActionScript and he wrote a lot of his own stuff” (WTran-209). But generally in programming subjects, when he asked students to “alter it [computer code copied from the Internet] or write something from scratch . . . invariably they’re very limited with that ability” (WTran-208). He cited the example of one online activity where

the learning outcome was to understand the difference between sequential and random access to files. He was disappointed that the students did not want to understand the technical explanations provided in the lessons: “They’re not . . . even interested in having a discussion about the content, they just want entertainment” (WTran-185). In some instances the students were interested in how the instructional material was visually presented: “Some will just put in comments about the colours or the layout” (WTran-176). He was also disappointed that in classrooms where students had access to the Internet they mostly liked to chat and play games and he found it “very hard to get them to clear the interference and to listen” (WTran-238). But he also believed that restricting students’ access to a rich resource like the Internet was not good teaching and stated that “it’s very hard, you don’t want to play a cat and mouse game of shutting down this port and that port and it just doesn’t work . . . (WTran-253). He planned to continue trialling instructional material in a variety of formats and styles and was resigned to the situation where “they just get a lecture once a month and then we go back to normal . . . [and that] you can only do what you can do” (WTran-259).

In summary, three broad themes emerged from Bill’s responses to the interview questions and from his observations of various online learning environments: First was the suitability of the MOODLE software to manage online delivery of curriculum. Second was the need to provide support for class teachers in general and IT teachers in particular, and third was the need to create online instructional material that students will find engaging.

In the next section theoretical considerations derived from major learning theories discussed in the Review of Literature Chapter 2 were used to examine data collected from Bill.

4.4.2 Theoretical Framework

Ally’s (2004) overview of research provides the theoretical framework for the examination of data collected from Bill. Examples of observable features expected to be found in learning environments or instructional material based on one of three major learning theories identified by Ally (2004) are presented in this section under the headings of these learning theories: Behaviourist, Cognitive and Constructivist.

4.4.2.1 Behaviourist

Behaviourist theory, discussed in the Review of Literature Chapter 2 is identified by Ally (2004) as producing “observable behaviour that indicates whether or not the learner has learned something” (p. 7). Features that Ally associates with Behaviourist theory were used to examine

online activities Bill had written for his students. Some of these activities were posted on the Software Development mailing list (www.edulist.edu.au/sofdev) and others were published in a textbook as a series of tasks for mobile devices. They directly address key knowledge and skills set down in the VCE curriculum 2007-2010. Examples which exhibit key features of Behaviourist Learning Theory are presented in Table 4.13 below.

Table 4.18 Bill: Features of Behaviourist Theory

Features of Behaviourist Theory Ally (2004) expected in online instructional material	Online Learning Assessment Activity Created/Described by Bill Demonstrated during the Interview
“Learners are informed of learning expectations so they can assess their own performance” (p. 7).	Bill commenting on online assessment tasks, “So I’ve got, my Year 12 one is especially useful, its got the full year’s course on there . . . all the key knowledge and the key skills” (WTran-77).
“Testing is integrated into learning experience to ascertain achievement and provide feedback” (p. 7).	“. . . it has a mapping to show which activities will address those key knowledge and key skills . . . it has hyperlinks to worksheets, or PowerPoints, or quizzes and so forth” (WTran79).
“Material is sequenced usually from simple to complex, to promote learning” (p. 7).	“. . .while they’re at the terminal, I’ve got to instruct them, say, “Okay, let’s go into the homework page. I’d like you to click on key knowledge number 7, and look up that- it’s on page 125 in your textbook, and there’s also two links to worksheets that I put up there, open those up. I’d like you to answer those questions, you can jump onto Google for anything that’s not sufficient in your [text] book” (WTran-247).
“Feedback allows learners to monitor their own progress and determine an action” (p. 7).	“And more feedback, more assessments I think is really important, like some of the TAFEs do. They’ve got a lot of online material that’s, some of its dry, but then again, when a student learns some of a module they can go off and do an assessment task to see how much they understood, I think we need much more of that” (WTran-689).

Discussed in the Review of Literature Chapter 2, Burton, Moore and Magliaro’s (2004) research expanded Behaviourist theory into the four sub-categories of Respondent Learning, Operant Conditioning, Observational Learning and Methodological Behaviourism. Data collected from Bill were examined for evidence of these four and found in the following three: Operant Conditioning, Observational Learning and Methodological Behaviourism.

4.3.2.1.1 Operant Conditioning

The first sub-category of Behaviourist learning theory evident in data collected from Bill was Operant Conditioning. Tutorials consistently showed automated sequences of cues, operands and consequences in line with a stated educational goal. In an interview Bill outlined online exercises which comprised automated sequences of cues/signals-operands-consequences. They fit the

structure described by Burton, Moore and Magliaro (2004) as learning activities monitored in order to provide a feedback loops known as “schedules of reinforcement” (p. 11). In the theory, these are associated with “complex learning, problem solving and transfer. Bill’s material did show strong evidence of this ‘cue-operand-consequence’ sequence. Examples presented in Table 4.14 below illustrate complex learning, problem solving and transfer within operant conditioning.

Table 4.19 Bill: The Antecedents (cues or signals), Operands Consequences Sequence

Features of Operant Conditioning Burton, Moore and Magliaro (2004) expected in instructional material	Features in Bill’s Online Learning Activities As Described by Bill
<p>Complex Learning: “chained behaviours . . . through practice and contiguity, the consequence [of one learning step] takes on a dual role and becomes the stimulus [for the next step] mechanism as relying on the learner building associations based on the simplest unit they have learned in an environment which provides contiguity and utilizes repetition” (p. 12).</p>	<p>“That’s the sort of thing I’d like to see. So it’s learning anytime, anywhere, not just in the 50 minutes in class. And more feedback, more assessments I think is really important, like some of the TAFEs do. They’ve got a lot of online material that’s, some of its dry, but then again, when a student learns some of a module they can go off and do an assessment task to see how much they understood, I think we need much more of that” (WTran-644).</p>
<p>Problem Solving: “tactical readjustment to changes in the environment . . . [a] trial and error experience the capacity to . . . controlling the sequence of material, monitoring the student’s progress and providing appropriate help results in the learner’s ability to generalize (respond the same way to similar stimuli) and discriminate (respond differently to varied stimuli)” (p. 12).</p>	<p>“Written from scratch. They drag and drop a puzzle piece onto the canvas, if it’s in the right place it snaps to the right place, if it’s wrong, it goes back to the pile. . . .then you’ve got to document it and then you assess your result” (WTran-705).</p>
<p>Transfer : “involves the replication of identical behaviours from [one] task . . . to a new task that has similar elements discriminate and to generalize as inversely related and as central in the processes that enable learning to be adapted and transferred to other environments” (p.12).</p>	<p>“And then it indicates when they’re going to do their assessment and then that gets put up and it’s hidden or revealed depending on what they need to do” (WTran-81).</p>

4.3.2.1.2 Observational Learning

The second sub-category of Behaviourist Learning Theory found in Bill’s data was Observational Learning. It is based on the idea that new behaviour can be learned by observing the behaviour of others. Burton, Moore and Magliaro (2004) note that this is also known as *vicarious* learning and derives from Social Learning Theory where learners observe “other people’s behaviour and its consequences for them.” (p. 12). Examples from Bill’s data are presented in Table 4.15 below to illustrate their fit with the components of Observational Learning: attention; retention; motor reproduction and motivation.

Table 4.20 Bill: Components of Observational Learning

Features of Observational Learning Burton, Moore and Magliaro (2004) expected in instructional material	Features of Observational Learning Described by Bill
<u>Attention</u> observers sensory capacity (perceptual set) Burton, Moore and Magliaro (2004) “Learners should be told why they should take a lesson so that they can attend to the information throughout the lesson . . . links to both simpler and more complex material can be used to accommodate learners at different knowledge levels” (p. 11).	“Yes. So students can contribute, they can upload material, they can chat to each other, in groups” (Tran-171). “Some will just put in comments about the colours or the layout” (WTran-176).
<u>Retention</u> “response patterns and how they are represented in memory in symbolic form” (p. 11).	“‘But you’re also watching them while they’re doing it and you’re closing and opening tests, you don’t have them open all the time. And the good kids will tell you, ‘Hey, there’s a problem with this sir, you’d better find it’ (WTran-744).
<u>Motor reproduction</u> “organisation of responses on the basis of feedback” (p. 11).	Bill commenting on students concerns, “. . . and I still wanted to show them that I was listening to them as long as they were able to produce something” (WTran-202).
<u>Motivation</u> “evaluative judgments that learners make about what they have learned and how it will affect their performance” (p. 11).	“. . .when a student learns some of a module they can go off and do an assessment task to see how much they understood, I think we need much more of that”(WTran-691).

4.3.2.1.3 Methodological Behaviourism

The third sub-category of Behaviourism found in data collected from Bill is known as Methodological Behaviourism and has been closely related to people using the automated processes that computers provide. This applies to the early teaching machines of the 1970s and the development of Personalized Systems of Instruction (PSI) models which use the Internet. This was discussed more fully in the Review of Literature Chapter 2. In the current section, automated instruction is restricted to consideration of three major components identified in Burton, Moore and Magliaro (2004), namely online question and answer (Q and A) tutorials, the management of complex conferencing and automated administrative procedures.

Table 4.21 Bill: Components of Methodological Behaviourism

Features of Methodological Behaviourism Burton, Moore and Magliaro (2004) expected in instructional material	Features of Observational Learning Described by Bill
Automated instruction: Training videos and audio visual instructional material, computers provide control of the sequence of material	“They drag and drop a puzzle piece onto the canvas, if it’s in the right place it snaps to the right place, if it’s wrong, it goes back to the pile” (WTran-705).
Online Q and A: Responses observed and analysed. Acting as tutors, and they can be programmed to respond to learners’ questions	“I’d like you to click on key knowledge number 7, and look up that it’s on page 125 in your textbook, and there’s also two links to worksheets . . . open those up . . . to answer those questions, you can jump onto Google for anything that’s not sufficient in your book. And then of course they’d be opening up five other windows with chat lines and other things and it’s just, to get them to focus” (WTran-246).
Automated tutors: Email and video conferencing, computers monitored learners determined when they needed help, selected the type of help and used the Internet provide appropriate help	“my Year 12 . . . it’s got the full year’s course on there that’s there from the start of the year, all the key knowledge and the key skills. It . . . has a mapping to show which activities will address those key knowledge and key skills. And it has hyperlinks to worksheets, or PowerPoints, or quizzes and so forth” (WTran-77)

The online material and automated processes created by Bill exhibit features associated with these components of Methodological Behaviourism. This is evidenced by: online question and answer (Q and A) tutorials that include automated quizzes, complex conferencing networks in the form of online mailing lists with forums for teachers and automated administrative procedures that include a spreadsheet analysis of students’ self tests with traffic lights to indicate a course of action.

In summary, the instructional materials collected from and described by Bill do exhibit features associated with Behaviourist Learning Theory, especially those which promote complex learning, problem solving and the capacity to transfer learned skills and knowledge to new situations. Bill’s descriptions suggest that he created highly organised online oncampus learning environments consistent with Methodological Behaviourism.

The next section uses Cognitive Psychology Learning Theory (CPLT) to examine online learning material created by Bill.

4.4.2.2 Cognitive

Cognitive Psychology Learning Theory (CPLT) is discussed in the Review of Literature Chapter 2. This is identified by Ally (2004) as an internal learning process involving the use of memory, motivation, thinking and reflection. His research concluded that online learning material which utilised CPLT would exhibit the seven features set out in Table 4.16. Activities Bill had created for his students were examined and found to show all seven of the CPLT features Ally expected. Examples are presented in Table 4.22 below.

Table 4.22 Bill: Features of CPLT Observed in Online Learning Material

Features Ally (2004) expected in online learning material based on the CPLT principles	Online Learning Activities Described/Created by Bill
Information carefully coloured and placed and paced to assists learners perceive and transfer it to working memory.	“Big Brother [software tutorial] produces HTML pages containing a simple matrix of hosts and tests with red and green dots to denote system status. Red is bad, Green is good” (WTran-297). http://download.cnet.com/Big-Brother/3000-2085_4-10424309.html
Information . . . grouped into generalized categories using information maps.	Bill used online activities in Krozian (2007) “Tasks and levels of difficulty” (p.41). “Learning Activities 1-8 Student Computer- Web Server- Web Browser” (p. 42).
help learners construct a link between information in long term memory and new information	Bill used online activities in Krozian (2007) “Green Box-Did You Know? PHP was originally known as Personal Home Page Tools and was publicly released on 8th June 1995 by Rasmus Lerdorf who combined it with his own Form Interpreter to create PHP/F1” (p. 39).
require learners to apply, analyse, synthesize and evaluate information.	Bill used online activities in Krozian (2007) “Exercises Try to add a loan while changing the bookID to a value that doesn’t exist. What happens/ explain your answer” (p.156).
materials . . . to suit various learning styles.	“I wrote up some notes on VB.net on the . . . site, I wrote up six, I was teaching Java and PHP and then I wasn’t teaching VB at all. And I had a blind student 3 years ago, who ran a program called JAWS to read the screen back to him, and JAWS just wouldn’t read Java. So, at 5 minutes notice, I had to teach him VB.net. So I had six Java, actually I had eight Java exercises” (WTran-297).
Support materials . . . appropriate to the learner’s preferred style.	“And there was some online training videos that I found that are, again, on the . . . site that were really good to show you how to do some of those skills. So he got enough out of it in that period of time” (WTran-318).
Learning material . . . constructed to motivate learners.	“He actually wanted to know how he could connect to my SQL server at the back . . . and I said, “That’s great,” ‘because that’s exactly what we’re going to do in Year 12, let’s see if we can do some of it in Year 11. So he really enjoyed that and he was . . . you could see the satisfaction and the success experience which was good for him” (WTran-212).

Ally’s (2004) research summary states that using colour and information maps helps students transfer information to working memory. The first two features in the Table 4.22 list as examples, coloured information maps that are found in online activities Bill used and/or created. The image

on the opening screen for online activities, shows a networked set of variously coloured and shaded screen icons as a stylized information map. This is a colour key and it is similar to information maps found in online material Bill has created. The maps are designed to help learners identify exercises, activities, technical definitions, key terminology and historical snippets that are associated with each learning activity. The green colour for example indicates exercises, activities, technical definitions, key terminology and historical snippets associated with a section entitled Web Server.

The online material created by Bill utilised colour and information maps to help students understand and transfer information to working memory. There was no evidence that students were asked to generate their own information maps which research cited by Ally (2004) and attributed to Stoyanover and Kommers (2002) states “requires critical reflection and is a method for externalizing the cognitive structure of learners” (p.10). Externalizing the cognitive structure of learners by map making activities and its benefit to learners, or to the creators of online learning material is considered further in the Conclusions, Chapter 6.

The other five features of CPLT presented in Table 4.16 above, relate to stimulating thinking processes associated with analysis, synthesis and evaluation, and providing opportunities and support materials for a variety of learning styles. The online material created by Bill showed examples of all five features.

The examples in Table 4.16 were further examined for evidence that they utilize four major cognitive strategies which are discussed in the Review of Literature Chapter 2. The first three memory, motivation and thinking are evidenced in the online learning activities created by Bill. The fourth, reflection, is not found in the data.

In summary, the instructional materials collected from and described by Bill do exhibit features associated with CPLT. The use of colour, placement and pacing in the creation of learning material for individual learners promotes complex learning, problem solving and the capacity to transfer skills and knowledge to new situations. Bill’s comments suggest that he was aware of the need to accommodate the social or external features associated with cognitive development theories of learning. In the next section Constructivist Learning Theory was used to examine comments and learning materials created by Bill.

4.4.2.3 Constructivist

This section presents findings from an examination of artifacts and comments made by Bill for evidence of features Ally (2004) associated with Constructivist Learning Theory. The theory and its influence on online learning as summarised by Ally (2004), and later Gredler (2008) is discussed in the Review of Literature, Chapter 2. From Ally (2004), Constructivist Learning Theory contends that “learners learn best when they can contextualize what they learn for immediate application and when they learn to acquire personal meaning” (p. 7). Bill recognised that the majority of his students were often more interested in using social media than achieving the learning objectives his online lessons were designed to achieve. He frequently observed his students “opening up five other windows with chat lines and other things . . . [and found it difficult] . . . just to get them to focus” (WTran-250). He recalled an unsuccessful strategy to try and engage their interest in computer programming

I said . . . Right, you can pick any language you like, okay? . . . And I will guide you if I don’t know the language. You need to show me what you can do and also get tutorial material that you have accessed about the language, and then I will guide you through it and we’ll see what you can develop at any level of competence, as long as you work and you don’t waste time”(WTran-190).

He was disappointed with the result because most of the students downloaded programming code that was pre-written and used it to play games with their friends. Bill accepted that social processes were determining what knowledge students pursued, and that he thought it necessary to credit the work students produced from this type of negotiated learning experience, and more importantly that he was seen to be listening to them. In a general comment about students playing games he stated that, “It’s also the interaction not just the quantity of knowledge” (WTran-190). In light of the theoretical framework derived from Ally (2004), the researcher believes that playing games with friends does contextualize what has been learned for immediate social application but whether it also helps students to acquire personal meaning is not obvious in the contexts Bill described.

Examples from Bill’s comments and online instruction material he created for students are set out against features expected to be found in a Constructivist Learning environment in Table 4.23 below.

Table 4.23 Bill: Features of Constructivist Learning Theory Observed Online Learning Activities

Features Ally (2004) expected in a learning Environment based on Constructivist Learning Theory	Features of Collaborative Learning in Bill's Descriptions of Online Activities
Strategies to make learning an active process.	“Why don't we do something that's more interactive, more fun? But I tell them that they've got their job . . . to build this stuff and I'm happy, Year 11 for example, I said to them in their programming, I said, “Right, you can pick any language you like, any language you like, okay?” (WTran-188).
Opportunities for learners to construct their own knowledge.	“I mean there's one student who's brilliant in Flash and ActionScript and he wrote a lot of his own stuff . . . he actually wanted to know how he could connect to my SQL server at the back . . . that's exactly what we're going to do in Year 12, let's see if we can do some of it in Year 11. . . . So he really enjoyed that . . . you could see the satisfaction and the success” (WTran-209).
An environment that encourages collaborative learning is promoted.	“So students can contribute, they can upload material, they can chat to each other, groups” (WTran-171).

Two of the three features Ally (2004) associated with Constructivist Learning Theory are evident in the learning environment Bill has designed, developed and implemented. Data collected from Bill contain the first two features: learning activities that provide students with opportunities to construct their own knowledge and activities are within a set of strategies to make online learning an active process. The third feature Ally associates with Constructivist Learning Theory is “an environment that encourages collaborative learning” (p. 7). Bill had negotiated with his students to provide such an environment and this resulted in the students working together and choosing the software they wished to study. This fits with the third feature and also echoes research findings by Gredler (2008) which state that, “constructivism assigns a major role to social processes which serve as criteria to determine content knowledge” (p. 19).

In summary, the data indicate that the online instructional environment created by Bill allows for learning experiences that fit with Constructivist Learning Theory. That is, students have opportunities to construct their own knowledge, learn collaboratively and make learning an active process.

In the next section the artifacts, observations and comments by Bill are further examined for evidence of innovations in instructional materials and curriculum delivery processes associated with use of the Internet.

4.4.3 Education and the Internet

For Bill, the Internet is a facility he can organise to provide the school community with access to up-to-date and relevant learning materials. When developing a local network for his own school Bill tried to see things from the perspective of all users: the teachers, students and parents. He stated, “When I build and manage the network here I always think back about the impact for the classroom, for the teachers, for the students” (WTran-190). He saw his own role as an intermediary between teachers and the technicians stating: “. . . I understand what the technical people need and I understand what the teachers’ need, so I think that [bridging the knowledge gap between technicians and classroom teachers] is important in a school” (WTran-583).

For teachers at his own school, he had built an online parent-teacher booking system, with a teacher-designed interface that had a space for parents to make comments. He explained that when parents were asked to comment, their main requirement was to have written information from the parent-teacher interview not just spoken comments which they would have to remember.

Bill aimed to devolve control of the school’s network to the classroom teachers. This is part of a larger scheme to make technical information accessible to all teachers who want to use the Internet to deliver curriculum.

For teachers in the broader teaching community, Bill had created a very successful and widely used system of subject-based emailing lists. Examples examined by the researcher included threads of discussions covering lesson plans and content in all areas of the VCE curriculum. The threads listed in the VCE IT folders found on the mailing list provided evidence of successful lessons that help teachers extend their repertoire to more technical areas of curriculum they might not otherwise attempt. By this means Bill actively develops and continues to support an environment that promotes collaborative learning amongst VCE IT teachers, and further, gives teachers the confidence to promote collaborative learning amongst their students. He declared his vision for an oncampus online learning environment with conviction:

So we’re trying to remove bottlenecks and facilitate information access, anywhere anytime with little or no help from the technicians, And you can see if it’s down, you don’t have to go finding somebody to confirm it. So we’re trying to make people independent [of technicians] and that’s the philosophical direction (WTrans-674).

In summary, Bill uses the Internet to organise innovation in a way that Drucker (1995) predicted would be essential to the survival of educational institutions. Bill developed and maintains a suite of automated mailing lists for teachers to share ideas and promote the use of innovations in technology. He provides online technical support for schools and teachers who want to use MOODLE software to put their curriculum materials online. He uses the Internet in a systematic way to facilitate educational transformation for students, teachers, schools and the broader educational community.

4.5 Case Gary

Gary is the Information Communication Technology (ICT) manager at an all girls government secondary college in Melbourne Victoria. He was an experienced ICT teacher and prior to the interview, an examiner for the Victorian Curriculum and Assessment authority (VCAA) and board member of the Victorian Information Technology Teachers' Association (VITTA). He had taught Year 12 VCE Information Technology for the previous ten years but at the time of the interview (GInt-00-00), student numbers were too low for the school to timetable a Year 12 ICT class.

The school had an intranet and encouraged teachers to use it. Gary stated that presenting the school's curriculum online was important because "students came from all over Melbourne" (GTran-610), and together with their parents, liked to be able to get their information at any time of the day, whether at home or at school. His belief in the need for an all-encompassing electronic learning environment underpinned many of his responses and influenced the themes that emerged when the data were analysed.

At the time of the interview the school had recently installed MOODLE management software and had flagged an intention to deliver all curriculum online. After a brief experience of MOODLE his initial observation was that all the students used MOODLE without difficulty, but that many staff did not. He stated that staff needed a program of ongoing training "to get them up to speed" (GTran-65). In an effort to overcome the perceived reluctance of staff, the administration had recently mandated that all materials set for a pre-VCE holiday program called 'Head Start' be presented online and ready for students to access by the end of the year. In response to this Gary was running a series of training sessions to help staff meet that objective. He considered provision of an online curriculum as being "in the real world" (GTran-80).

During the course of the interview Gary discussed a number of factors which he believed influenced the effectiveness of an online, on-campus learning environment. The first was to find a practical delivery platform with a good match with the curriculum, the second to manage the cost of constant equipment upgrades, the third to train staff and the fourth to ensure that the online assessment procedures were secure. These are discussed in the next section as emergent themes.

4.5.1 Emergent Themes

The four emergent themes derive from Gary's descriptions of the electronic environment the school aimed to create. They form the components of strategies that had been developed as the school's network evolved. These factors fall into the following four categories:

- finding the right delivery platform and matching curriculum to that platform
- managing the cost of constantly upgrading ICT equipment
- training staff to a comfortable level of confidence
- securing the online environment for examinations

i The first emergent theme: delivery platform to fit the curriculum

Over the years the school had tried out a number of hardware and software configurations for a network: "we've been trying to get an intranet working for 10 years; and we've . . . tried different things; [and finally settled for] a combination of Microsoft Share Point (software for managing file sharing on a network), and MOODLE" (GTran-128).

The school had initially considered using Microsoft SharePoint software alone to manage the delivery of its electronic curriculum, but decided that it was principally designed for business and was not "an exact fit" (GTran-219) with education. Gary explained that the school had recently settled on the MOODLE management software because it was "aimed at education" (GTran-224). For Gary, MOODLE was central to making the school's networked curriculum work because "it's more student based and . . . it's got a week by week view; it's got a topic view; it's got the ability to put kids into groups. It's got a lot of features that make it useful in a school context" (GTran-244). They had also investigated other management software tailored for curriculum delivery such as Blackboard (software used by many universities to manage electronic delivery of curriculum), but had decided against the Blackboard software because "it had more of a university feel; it was set up to fit those needs more. Whereas MOODLE seems more . . . like it fits really well into the school context" (GTran-238).

Once MOODLE was established on a school-wide basis they added other "software packages to do different things . . . and brewed something that's like the Ultranet" (GTran-128). (The Ultranet is a Victorian Government initiative to provide a "state-wide, secure site that students' parents and teachers can access via the Internet" (www.education.vic.gov.edu/about/directions/ultranet). It has four major sections accessed by

the links Learning Tasks, Collaborative Learning, eXpress Space and Community).

ii The second emergent theme: the ongoing costs of upgrading software and hardware

Gary believed that the Victorian Government would like to see all schools using the same platform to deliver online curriculum so that core elements of curriculum could be available via the Internet in a standardized format. This would also allow the Government to negotiate the cost of both software licences and networking hardware components and by this means reduce many of the costs associated with constantly updating ICT equipment. At the time of the first interview Gary believed that the Government was working to provide “a standard set of programs for all the computers in Victoria” (GTran-1400). To achieve this, the Government has an ongoing initiative to help schools purchase certain prescribed hardware and software items, which were referred to by Gary as “on the education list” (GTran-1541).

In Gary’s view, with so many different models of teaching in place and so much complexity associated with every choice individual schools had to make, complete standardization was not “going to work very well” (GTran-1401). Many of the projects the Government promoted were set-up in primary schools and he believed that “the uniqueness of schools [meant] you can’t take something from a primary school and translate it into a secondary school” (GTran-1394). However the bulk purchase policy did work for software products that are widely used like MOODLE and PaperCut. (MOODLE is used to manage online curriculum delivery in many schools. PaperCut is used to manage students’ Internet and printing accounts, in particular wireless printing in most schools). The printing budget is an increasingly important component of school budgets as mobile technology becomes more widely used in education. PaperCut engages students in the school’s efforts to minimize the use of paper. Students, for example, can link to major sections such as ‘Save Paper’, ‘Track Printing’, ‘Quota Printing’ and ‘Environmental Impact’. For Gary these features and the fact that it was free to schools meant PaperCut “was probably the best one to use” (GTran-1541). He gave examples of other hardware and software on the free list declaring that the education authorities “are doing a lot of good things, I just think if they had more money, it would be better” (GTran-1543).

Gary suggested that the costs associated with updating ICT equipment could also be reduced by using Open Source software wherever feasible. (Open Source refers to software made available by its authors, to others free of charge.) The school used an Open Source version of MOODLE and found the only problem was the lack of ready technical support to fix ‘bugs’ that arose from

time to time. Gary explained that with Open Source programs “it takes time to fix bugs because you haven’t got a paid team who will work on it all the time, so there is a small downside” (GTran-263). He believed that if the Government funded a support mechanism to fix those types of bugs the use of Open Source software for curriculum delivery could be much more cost effective.

In a final comment on the changing focus of budget allocations, Gary explained that the school was moving towards an ICT environment and as a consequence, there was for example, less funding for the printed book and staff associated with operating a traditional library. Re-aligning budget priorities in this way is identified as a successful strategy in *Educational Resource management: An International perspective*, where Glover and Levacic (2007) state that the budget can act “as a stimulant for change by highlighting the need for forward thinking” (p. 88). For Gary the strategy was working because he had noticed that ICT requirements were increasingly regarded as normal budget items. In the past, much of the ICT equipment was purchased outside normal budget processes, for example, using “locally raised funds, and . . . grant money from DEET” (GTran-1435). By the time of the interview the Ultranet, MOODLE and PaperCut were part of the school’s normal learning environment. As Gary notes, “We have a web, we’ve got a web charging system, . . .” (GTran-1505).

iii *The third emergent theme: training staff to function in an online environment*

In the year prior to the interview the professional development activities designed to help teachers function in the online environment were not as popular as Gary had hoped they would be. He states, “We’d offer PD and two people would turn up, which is really depressing” (GTran-667).

After consulting more closely with the teachers he refocused the professional development program on to three specific tasks associated with delivering curriculum online. These were: using the information management software package called Inspiration www.inspration.com, to integrate digital learning objects into instructional material; and operate the interactive whiteboards in the classrooms. In Gary’s words, “So the PDs [Professional Development activities] that we’ve run this year, have been based around things like Inspiration; using digital learning objects, the interactive whiteboards . . .”(GTran-677).

The first focus for the PD program was Inspiration www.inspration.com. This software product promotes itself as using “research based principles and strategies to support our visual thinking, and

learning software for students and educators” (Appendix H). It is on the education list and as a consequence is widely used in Victorian primary and secondary schools. It provides a standard set of headings and information map structures for presenting subject outlines and topic headings, as well as a standard format for all assignment and assessment documents that are uploaded to MOODLE.

The second focus of the PD program was interactive whiteboards. These are connected to the school’s intranet and allow classroom teachers to display course outlines, lesson objectives and lesson instructions on a white surface. They also link material directly to and from teachers’ laptops as well as to and from students’ laptops. The advantages of this facility to classroom management and instruction are discussed more fully in the Literature Review, Chapter 2.

The third focus of the PD program was digital learning objects. These are learning activities that are stored as a digital resource and are therefore available online. Students can copy them via the school’s intranet or copy them directly onto their own personal mobile devices. The government website ([www.education.vic.gov.au/student/learning/teaching resources](http://www.education.vic.gov.au/student/learning/teaching/resources)) has a large number of examples for teachers to access under the title Using Digital Learning Objects. It provides good ideas for secondary teachers but relies on them having a broad knowledge of pedagogies to create higher level content and then integrate that content into a lesson. It also requires a teacher to have sufficient technical skills to trial a newly developed lesson on the school network. Gary believed that focusing on teaching the skills associated with using digital learning objects was more effective than persisting with subject based PD because digital learning objects and applets (small programs dedicated to specific tasks such as drawing graph curves) were becoming available for more subject areas, and while the number of subjects had increased, the time available for PD had remained the same.

In a general comment Gary observed that in the past PD had been delivered either too quickly without much planning to meet an immediate need or too slowly to really help teachers. The current PD strategy was to try to respond quickly to problems associated with any new software and hardware but within a larger framework of forward planning.

iv The fourth emergent theme: managing examinations online

The school had trialled some settings for formal assessment of students online and identified

technical and organisational areas where problems with security had arisen. Gary recalled for example, that it was difficult to stop students from reading one another's screens across the room. He joked that, "The best idea I think we came up with was a cardboard box to go around the computer and you [the student] sit in the cardboard box" (GTran-1639). Gary believed that securing assessment in an online environment would become more of an issue if the state Government mandated online exams for the VCE. The difficulties Gary observed in the area of computerized performance assessment are reflected in the research of Baker, Chung and Delacruz (2008). They conclude that in future "the processing power of computers will be used to create learner profiles (rather than scores or classifications)" (p.602). This is discussed in the Review of Literature, Chapter 2.

The four themes that were outlined in this section emerged from an analysis of Gary's responses to questions and his observations of his particular school's online learning environments. They encompass finding the best delivery platform to fit the curriculum, managing the ongoing costs of upgrading software and hardware, helping staff to function in an online environment and managing examinations online.

In the next section Gary's responses to questions, the artifacts collected, online instructional environment observed in the school and field notes made by the researcher were examined in light of theoretical considerations derived from major learning theories discussed in the Review of Literature, Chapter 2.

4.5.2 Theoretical Framework

Gary's role as an ICT innovator within the school's leadership team influenced his responses to the eight standard questions used to frame all the interviews in this study by giving him a broader perspective. He spoke as an ICT leader as well as a teacher of VCE computing. The examples of computer hardware and software he discussed were in the context of providing an online and oncampus learning environment for the whole school as well as his own classroom. The hardware and software he selected for the staff professional development programs for example, were part of a larger strategy to encourage teachers to use interactive whiteboards already in the classrooms and to develop their online instructional material using digital learning objects within the consistent format provided by a software program called Inspiration.

The interactive whiteboards he described were connected to the school's intranet and provided instant online access to curriculum material such as course outlines, assessment requirements and resource references as well as to learning objectives for individual lessons. Research by Glover, Miller, Averis and Door (2005) suggests that in this environment classroom management and students' learning behaviours are changed. First, students and teachers draw on the wider range of resources provided by the Internet and secondly, in classroom interactions, "the kinesthetic capacity of the software . . . [leads to] an increased use of pupils as demonstrators" (p. 158). Glover et al go on to predict that learning in an environment where students can Google for ideas/facts/opinions as part of any learning activity will influence the pedagogy. They assert that pedagogy will adapt from teacher centred 'chalk and talk' to interactive. In this environment teachers for example, will use interactive whiteboards to integrate audio visual media technologies into lessons. These predictions are discussed in the Review of Literature Chapter 2. The information structure provided by Inspiration software and the type of access to curriculum information that interactive whiteboards enables, emerged as important components in the online and on-campus learning environment Gary described. These were factors to be considered when the data were examined for features expected to be found in learning environments based on one of three major learning theories identified by Ally (2004) and more recently Gredler(2008). These are Behaviourist, Cognitive, and Constructivist learning theories. The results are presented in the next section.

4.5.2.1 Behaviourist

Behaviourist learning theory discussed in the Review of Literature Chapter 2 is identified by Ally (2004) as supporting Behaviourist strategies that can be used to teach the facts, or as he phrases it "the what" (p. 24). Features that Ally associated with Behaviourist theory were used in this study to examine the online on-campus learning environment Gary described, in particular, the focus of the PD program which was to encourage teachers to use Inspiration software, interactive whiteboards and digital learning objects. Table 4.24 below presents examples from Inspiration software and the Internet both of which are accessed via interactive whiteboards. These are set out against features Ally (2004) expected to find in an online learning environment based on Behaviourist learning theory.

Table 4.24 Gary: Features of Behaviourist Theory

Features of Behaviourist Theory Ally (2004) expected in an online learning environment	Examples from Inspiration software , interactive whiteboards and digital learning objects evidenced in Gary's descriptions of the online, on-campus learning environment
"Learners are informed of learning expectations so they can assess their own performance" (p. 7).	Inspiration's outlining feature, for example, provides a "preliminary outline of written work organised headings and subheadings. . . . [and] Organised thoughts related to a topic" (www.inspiration.com).
"Testing is integrated into learning experience to ascertain achievement and provide feedback" (p. 7).	Gary commented on both his school's and the Government's ongoing trials to integrate testing into online learning activities. This was problematic in the online environment as VCE is an accredited course and requires students to demonstrate individual achievement on performance assessments. He had trialled online exams and found it was "almost impossible for you to set up an environment where the students can't look at each other's work" (GTran-1626).
"Material is sequenced usually from simple to complex, to promote learning" (p. 7).	Inspiration's mind mapping feature, for example, provides a "visual form of note taking that offers an overview of a topic and its complex information" (www.inspiration.com).
"Feedback allows learners to monitor their own progress and determine an action" (p. 7).	Gary's colleague explained that students were able to use math applets from the Internet to experiment and find the right technique for the particular problem. "You take a bit of time, you can't do too many complete sums and find the right [one]" (GTran-773).

Inspiration software provides a number of tools in a standard format that teachers and students can rely on for a consistent presentation of information within the school's interactive learning environment. The outline features, for example, enhance learners' access to curriculum documents such as course outlines, learning objectives and performance expectations. Mind mapping supports other features Ally (2004) associates with a Behaviourist learning environment, such as logical sequencing of visual learning activities, simple-to-complex learning activities and problem solving activities. The features of Inspiration software and their relationship to Behaviourist Learning Theory are discussed in the Review of Literature, Chapter 2.

The PD program which Gary described was focused on using Inspiration software, interactive whiteboards and digital learning objects in a school-wide online environment. In combination these three provide highly structured formats for presenting curriculum and support for the careful sequencing of learning activities. Ally asserts that highly structure formats and careful sequencing are consistent with Behaviourist learning theory. In the next section Cognitive Psychology Learning Theory (CPLT) was used to examine descriptions and observations of the online learning environment recorded in interviews and discussions with Gary.

4.5.2.2 Cognitive

Cognitive Psychology Learning Theory (CPLT) discussed in the Review of Literature Chapter 2 is characterised by Ally (2004) as a set of cognitive strategies that address internal learning processes involving the use of memory, motivation, thinking and reflection. As he writes, they can be used to teach the “how” (p. 24). The researcher examined Gary’s descriptions of Inspiration software, the Interactive Whiteboards and digital learning objects for features Ally associated with an online learning environment that would support CPLT. Table 4.25 below presents examples from Inspiration software and the Internet, both of which are accessed via interactive whiteboards. These are set out against features Ally (2004) expected to be found in an online learning environment based on CPLT.

Table 4.25 Gary: Features of CPLT Observed in Online Learning Material

Features Ally (200) expected in online learning material based on the CPLT principles	Examples from Inspiration software, interactive whiteboards and digital learning objects evidenced in Gary’s descriptions of the online, on-campus learning environment
Information carefully coloured and placed and paced to assist learners to perceive and transfer it to working memory	Inspiration software mind mapping, for example, “through the use of colours, images and words –begins with a central idea and expands out into more in-depth sub-topics” (www.inspiration.com/Resources).
Information . . . grouped into generalized categories using information maps	Inspiration software webbing, for example, “shows how different categories of information relate to one another. Brainstorming method that provides structure for ideas and facts” (www.inspiration.com/Resources).
Help learners construct a link between information in long term memory and new information	Inspiration software visual learning, for example, claims “learning is better understood . . . and relevant when ideas, words and concepts are associated with images” (www.inspiration.com/Resources).
Require learners to apply, analyse, synthesize and evaluate information	Inspiration software concept mapping, for example, “helps students represent and organise knowledge of a subject. Links concepts and ideas together with words and phrases that explain the relationship” (www.inspiration.com/Resources).
Materials . . . to suit various learning styles	Gary’s colleague explained that she used the interactive whiteboard to demonstrate “. . . little Maths Applets [small programs with specific functions]”(GTran-773). Schools were provided with similar programs on a CD entitled <i>Implementing the VCE VCAA</i> (2006c). (Appendix F).
Support materials . . . appropriate to the learner’s preferred style	Students search for YouTube audio visual instructions to meet their own learning needs. “Who knows what is going to be required to keep it relevant for students; we might have to have embedded You Tube videos in it” (GTran-194). Inspiration software Audio/visual graphic organizer provides “a visual display that demonstrates the relationships between facts, concepts and ideas” (Appendix H).
“Learning material . . . constructed to motivate learners” (p.16).	Gary believed that eventually the Internet would motivate students interest in learning “The ultimate stage is where the kids are interacting with the [white] board and you’re just sitting there; it’s not directed” (GTran-914).

Inspiration software exhibits all of the features Ally (2004) expected would be found in an online learning environment based on CPLT. These include:

- Online documents uploaded to the school's intranet which used standard colour and font sizes to assist with navigation;
- Diagrams and information maps used as alternatives to text based communication;
- Interactive whiteboards that provide whole-class access to curriculum documents in a transparent way that encourages adherence to a school-wide standard.

The interactive facility of the whiteboards allows individual students to choose support materials that utilize embedded audio and video learning activities. This then, potentially, gives learners the opportunity to access learning material appropriate to their preferred style and stimulate an interest in the topic. With respect to class management, Gogill (2007) found that at the beginning of a class, an interactive Whiteboard “provided a powerful linking process between a teacher and his or her pupils through verbal, visual, and cognitive interaction with images and content displayed on a Whiteboard” (p. 170). This is an important feature in a VCE class because the content is mandated and the teacher needs to finely manage the learning environment and at the same time motivate students, and allow them to select their preferred instructional material.

In the next section Constructivist Learning Theory was used to examine descriptions and observations of the online learning environment that were recorded in interviews and discussions with Gary.

4.5.2.3 Constructivist

Gary's description of the online learning environment has features that are strongly reflected in the components of Constructivist Learning Theory discussed in the Review of Literature, Chapter 2. From Ally (2004) constructivist theory contends that “learners learn best when they can contextualize what they learn for immediate application and when they learn to acquire personal meaning” (p. 7). He explains that constructivist strategies can be used to teach the ‘why’, that is, “higher level thinking that promotes personal meaning and situated and contextual learning” (p. 7). Table 4.26 below presents examples from Gary's descriptions of the school's online oncampus learning environment set out against features Ally (2004) expected to be found in a learning environment based on Constructivist Learning Theory.

Table 4.26 Gary: Features of Constructivist Learning Environment Observed

Features Ally (2004) expected in a learning environment based on Constructivist Learning Theory	Examples of, interactive whiteboards and digital learning objects evidenced in Gary's descriptions of the online, oncampus learning environment
"Strategies to make learning an active process" (p. 18).	"Yes, and sharing their experience; it's really good for them; it's used a lot for presentations. So a kid, if they've got a presentation PowerPoint or a video or something they've made, they can show it and then they could talk to it and they can annotate it to ..." (GTran-927).
"Opportunities for learners to construct their own knowledge" (p. 19).	Given Wiley's (2008) assumption in <i>The Learning Objects Literature</i> "that humans will be involved in the process of localizing learning objects, and they rely on learners to engage in selecting what they want" (p.352). The researcher believes that in promoting the school-wide use of digital learning objects via the Professional Development program, Gary is supporting the development of an environment where learners, both teachers and students, have opportunities to construct their own knowledge.
"An environment that encourages collaborative learning is promoted" (p. 19).	"Well, it's really good for sharing student work, peer evaluation; and for kids to show other kids something they found on the internet. And also a lot in maths, I've seen some of their maths teachers get the kids to go up and they can actually solve a problem online, that sort of stuff" (GTran-912).

Three learning technologies, Inspiration software, interactive whiteboards and digital learning objects were central to the to the PD program objective to promote the school-wide use of ICT. Separately they provide a broad framework for what Ally (2009) called "a text based, template-produced electronic delivery online course" (p.177). Ally (2004) raises the point that a new computerized delivery system is often used to provide the traditional distance education model online. In particular that it "does not make any use of the multi-modal, computer mediated instructional means that are available" (p.177). The researcher believes that combining the PD initiatives in the way Gary describes provides the means to overcome this failing because it encourages teachers and learners to make use of the multi-instructional means.

By integrating Inspiration software, interactive whiteboards and digital objects into learning activities, teachers have the opportunity to create an online learning environment that supports what Ally (2009) describes as "active learning that resides in the control of the student" (p. 182). This supports an environment where teachers and/or students can integrate what Wiley (2009) calls "permissive learning objects into lessons" (p. 352). The term 'permissive' refers to the fact that all digital resources can potentially be combined to form new learning objects regardless of their source. This is a learning environment where teachers and students can be involved in the process of selecting and localizing the learning objects, and is therefore consistent with Constructivist learning theory.

At the time of the interview, students' main access to the school's intranet and the Internet was via wireless and wired laptops. As the study progressed, the increasing variety of mobile communication devices available to students added a new dimension to the online learning environment and altered the design requirements for oncampus and online instructional material. It also facilitated the capacity for collaboration and the co-construction of knowledge via increasing access to the Internet. The relationship between the Internet and a learning environment based on Constructivist Learning Theory are discussed in the Review of Literature, Chapter 2. In the next section Education and the Internet, examples from Gary's descriptions of how the Internet is used in the school are examined.

4.5.3 Education and the Internet

For Gary the Internet brought him the challenge to keep abreast with the constant changes in the technology students were using to communicate with the school intranet and each other. It allowed the college to provide a total curriculum in a standardized format and teachers the opportunity to share and thereby participate in a process to improve lesson plans.

i Keep abreast with changes in mobile communication technology

Gary recognised the accelerating nature of this change when he said "Who knows what is going to be required to keep it relevant for students; we might have to have embedded You Tube videos in it, well, -you know?" (GTran-194).

Gary's aim was to keep the school's software upgrades abreast with students' requirements. He states, "We look at upgrading on a regular basis; and we look at what's actually going to be used by people" (GTran-1159).

ii Provide an environment for collaborative learning that extended to teachers

It was Gary's hope that teachers would gradually integrate their use of Inspiration software, interactive whiteboards and digital learning objects into lesson plans. Gary has provided what Mishra and Koehler describe as an online learning environment that can facilitate the sharing of lesson plans and conversations about students responses to learning activities and as a consequence, classroom management strategies.

Gary recognised the difficulties teachers face when they have to adapt an online oncampus learning environment when he stated, “There are pressures in just getting teachers to get their head around the interdisciplinary nature of ICT” (GTran-114).

iii Total curriculum in a standardized format online

Gary’s decision was to focus the PD program on the combined use of Inspiration software, interactive whiteboards and digital learning objects. The standard format provided by Inspiration software and the communication enabled by interactive Whiteboards linked to laptops, tablets and mobile phones provide an environment where collaborative learning can occur.

For Gary the Internet gave students, parents and teachers access to all the school’s curriculum information. Using the standard format provided by the MOODLE curriculum delivery platform, and Inspiration software, the school’s administrators could provide all the features Ally (2004) expected in an online learning environment. The school’s intranet includes general information about student log-in and password procedures and how to enrol for courses. Ally also lists specific information that should appear on public pages such as: “course syllabus . . . instructor contact information, . . . course overview, course schedule, . . . list of required texts and materials . . . clearly defined academic and computer skills, prerequisites, clear communication about expectations instructions, about activities, assignments and deadlines, faculty contact information . . .” (178). These features are evident on Gary’s school website for all courses including the VCE IT curriculum, which is set out in a separate major section.

Across the school and across the curriculum Gary was moving to put everything online. He states, “Generally a real thrust has been to try and put as much stuff through the intranet as possible, because it’s much more assessable” (Tran-1164). The curriculum was available then on the intranet, where content is controlled and managed by the school. Students and teachers could also use the Internet and its vast and uncontrolled pool of learning material.

In summary, Gary was moving the teachers towards providing what Ally (2004) characterised as “courses which take advantage of the Internet as a teaching and learning environment” (p.177). Gary had observed that when teachers saw the Internet used in their home environment they were motivated to use it because “they can see their own children using computers all the time, see that it’s relevant and they know they’ve got to be relevant . . . they use computers to do things for

themselves . . .” (GTran-1131). He believed that if teachers had enough good experiences with the Internet and ICT in general, and because they along with students were influenced by the increasingly widespread use of mobile learning technology, they were likely to go on to create what Ally (2004) classified as “learning material . . . constructed to motivate learners” (p.178). In this environment teachers become learners themselves.

4.6 Case Daniel

Daniel heads the ICT Faculty at a large co-educational multi-campus secondary college in Victoria. He has responsibilities at the city campus for inducting staff and training them to use the information and communication technologies required to deliver the online curriculum. He also manages the college-wide training program for students at Years 10 and 7 and 5 and for the Prep. to Year 4 classes at the school's junior campus. Daniel liaised directly with the Head teachers of other campuses and faculties, and in this role saw himself as an "interface between the IT Department and the Teaching area" (DTran-187). As part of this role he had written a Learning Technology Report (LTR) for his school community.

At the time of the interview in 2008, Daniel was teaching two Year 11 VCE ICT classes and two Year 10 preparatory VCE ICT classes. One of the Year 11 classes studied the use of application programs such as Microsoft Access and Excel and the other Year 11 class studied computer programming. He was well known to the ICT teaching community in Victoria as the author of a number of VCE Computer Science exam-primer booklets and more recently, for a course of e-learning activities available on CD. "I've written a couple of CDs and I've put them up on the [school] network and provide them for the classes and the programming side of things" (DTran-263).

Daniel organised both his VCE classes so that students worked in teams and used ICT to create information solutions for business organisations. Over the course of the interview it became clear that his enthusiasm was for team-based ICT learning activities, particularly those that integrated ICT skills acquisition with business communication. "What they have to do is . . . skill based, because it's completely focused on . . . 'doing' in terms of the business communications, . . . you look at what communication processes and techniques you might use to more efficiently . . . communicate your ideas to someone else." (DTran-108).

In his role as Head of the ICT Faculty, Daniel had recently investigated how the various faculties used ICT, and collated his findings in a Learning Technology Report (LTR). The Report contains for example, descriptions of "the uses of the tablet computers inside the classroom by both teachers and students" (DTran-189). He explained that as the Report was "the first for a number of years . . . and was a brief analysis . . . it talks a lot about the laptop [program] and has some vision about the future . . ." (DTran-216). In general, his aim in writing the report was to raise strategic concerns, for the college, in two areas: future software needs and directions for network management.

In the next section, the transcript of interview, artifacts collected from Daniel and the Learning Technology Report were examined for emergent themes.

4.6.1 Emergent Themes

When the interview transcript and Learning Technology Report were examined by the researcher, one theme emerged and was categorised as: *Online Learning Activities for Teams Working in Simulated Business Contexts*. This theme was established as a major theme, and as it was directly related to the VCE online learning environment which is the main focus of this study, the data were further examined for sub-themes that could enhance understanding of the major theme. Two sub-themes emerged which were nominated as: *Providing for Different Learning Styles*; and *Utilising Readily Available Technologies and Mobile Communications*.

The major theme and the two sub-themes were then used to examine the online learning environment Daniel described.

i. *Major emergent theme: online learning activities for teams working in simulated business contexts.*

Daniel explained that in his own classes he was emulating a workplace environment. Students worked in teams to create an information product for a specified organisation. They were “actually working as a team in a workplace, producing a product, . . . [and learning the] theory behind how to maintain the software and equipment” (DTran-124). He explained that the theory associated with the use and maintenance of software and hardware was studied when the need arose. Students would download, for example, the manuals for digital ‘still’ and video cameras. As he explained, “We need the manuals for the cameras, . . . because we have ‘still’ digital cameras as well as video cameras” (DTran-98). Simulating a business environment allowed him to cover in a more realistic way both the legal obligations and ethical considerations associated with Health & Safety, because students understand legalities and ethics in a context where there are contractual obligations that include time lines and product specifications.

Daniel believes that the school community supported the notion of an ICT curriculum centred around business communication and using digital media because many activities contributed to the acquisition of business skills such “making animations or video or web pages or using Photoshop to dress up photos” (DTran-55). He considered that the ICT skills taught in this context by the ICT department were at a fairly high level and that they were meeting a need that

the Art Faculty, for example, could not. Daniel hoped that other enjoyable activities like designing personal pages on MySpace and Facebook could be built into course outlines and by these means, business concepts such as project management and web design could be “taught surreptitiously”(DTran-124). He had discovered that the theory and practice of database management, for example, could be taught successfully using “the software inside the iPod, [because] the iTunes software is . . . [like] running a database and you can organise things, you can do lists and you can select things out of that” (DTran-55). He had observed similar learning processes where a lot of the functional elements associated with file management, for example, were learned as students interacted with the school’s network, which he characterised as massive and complex. Additionally teachers in all faculties expected students to have the skills to stay connected and share work files, because learning outcomes in the 2011-14 VCE ICT curriculum were beginning to show up as key skills in other subject areas. It was the responsibility of the ICT faculty “to cover those” (DTran-170), and he believes that teaching these skills in a simulated business context was the best way to do this.

ii. First emergent sub-theme: providing for different learning styles

Daniel had observed that many students preferred to learn by doing and that most of the online learning activities in the simulated business environment suited those students whom he described as “having a doing it type of attitude as opposed to a theory base” (DTran-114). He believes that when all the ICT learning material was available online it would be possible to organise the learning outcomes in a way that allowed students working towards different certificates to learn together in teams. Students, who are less academic, for example, can meet the learning outcomes for VET courses and work in teams with students studying the more theoretical VCE Software Development. To this end he had analysed the learning outcomes of a number of Certificate Courses and grouped them on the timetable so that students who preferred more ‘doing’ could achieve, for example, a VET Certificate in Creative Industries Media.

Daniel believes that making course outlines, learning outcomes and classroom activities available online gave students the chance to create subject groupings that better suited their preferred learning style. From his perspective, the boundaries between faculties had to be broken down so that the ICT skills required for tasks in all subject areas could be taught in an online environment. In one instance “he had moved the VET and VCE Multimedia into the ICT faculty, [which resulted in] in Year 12 . . . and Year 11 doing a new course . . .” (DTran-15). He had noticed a trend across the school, and the Art Faculty in particular, “where they want to do a lot more in the

communications [and] business side and a lot of things in the digital media side . . . either making animations or video or web pages or using Photoshop to dress up photos . . . fairly high level IT skills in using applications that they can't support . . . ” (DTran-56). Opening up the course structure and providing the learning activities online helped the ICT faculty to meet teaching obligations in other subject areas, and gave students more subject choices, because potentially, it reduces the restrictions on subject combinations imposed by the practicalities of timetabling rooms and teachers.

iii. Second emergent sub-theme: utilising readily available technologies and mobile communications

Daniel believes that the ICT curriculum worked best when it was connected to the students' everyday use of technology. To this end he had adapted course content and learning activities to take advantage of email, MySpace, Facebook, YouTube, mobile phones and Tablets, with an emphasis on business communications in a global online environment, and made it possible for students to access “their timetables and a Blackboard delivery system of class materials” (DTrans- 246). Blackboard is curriculum delivery software used widely in tertiary institutions . He estimated that WebCT/Blackboard was used by about a third of the staff, those who were “more technologically literate” (DTrans-257). More recently there was a trend for all staff to use popular and readily available technologies. He stated that “a lot of teachers are moving things to WIKI-spaces”(DTran-259), and noted in the Learning Technology Report that “YouTube is one of the most widely used Websites across many curriculum areas” (DLTR-3).

The college had a formal PD program which operated regularly on Tuesday and Thursday lunchtimes where “teachers come to one of these rooms . . . and learn about interactive whiteboards or the tablets and linking into different programs but online” (DTran-263). Daniel's school, like many others, was interested in linking interactive whiteboards and mobile technology to learning outcomes, along with appropriate class and homework activities. The strategy he set out in the LTR aimed to extend the use of business communication technology and take advantage of the students' liking for mobile communications. In his view the curriculum could be organised to make “better use of all technologies currently used at home” (DLTR- 22). He aimed to have mobile phones and iPods “play video and sound files made in class” (DLTR-25).

4.6.2 Theoretical Framework

Daniel's responses were then read for features associated with three major learning theories. Ally (2004) identified a range of features expected to be found in online learning environments or

instructional material based on one of three major learning theories. The results are presented under the headings of these learning theories: Behaviourist; Cognitive and Constructivist, which are discussed in the in Chapter 3, Review of Literature.

4.6.2.1 Behaviourist

Behaviourist theory discussed in Chapter 3, Review of Literature, is identified by Ally (2004) as producing “observable behaviour that indicates whether or not the learner has learned something” (p. 7). Examples of online learning activities described by Daniel that exhibit these features are presented in Table 4.27 below.

Table 4.27 Daniel: Features of Behaviourist Theory

Features of Behaviourist Theory Ally (2004) expected in online instructional material	Examples of Online learning activities cited from the Transcript of Interview and the Learning Technology Report
“Learners are informed of learning expectations so they can assess their own performance” (p. 7).	Daniel speaking about student access to curriculum documents “ ... there’s a number of ways they do that. There’s a thing called, well, the intranet; they can log into the intranet and they can see probably their timetables and they can see WebCT” (DTran-245). “College intranet design has grown Redesigned to incorporate the latest in communication technology. Parents keep informed of curriculum expectations for students” (DLTR- 4).
“Testing is integrated into learning experience to ascertain achievement and provide feedback” (p. 7).	“So here they see all this network . . . they can go Cert II or Cert III, . . . then we can look at photo images and so there’s a pop art thing . . . there’s the learning tool they use so what they have to do is to basically copy what I have done and that’s to get that pop art image so they have to learn to use the camera” (DTran-842).
“Material is sequenced usually from simple to complex, to promote learning” (p. 7).	“Now I’m changing the colour of the clouds. Then I’m going to my original photo and making a crimson sunset and then I’m getting serious and I’m doing colour replacement so I’ve got my red car, I’ll change it into a purple car and I left that bit there to point out if they wanted to, if they’re not careful and lift their pen up you’ll colour anything purple but if you hold it down you can just go straight over the whole lot and then can re-colour that with the fence colour. And so then I have got a text behind layers so there’s different layers with the text and so you can actually have different text effects in the poster” (DTran-887).
“Feedback allows learners to monitor their own progress and determine an action” (p. 7).	“WIKIpedia provides experience in using Web 2.0 . . . encyclopaedia is one of the most widely used educational sites across the globe and our college is no exception . . . retrieved information is changed by user contribution on a daily basis” (DLTR-5).

Statements in Learning Technology Report indicate that features of Behaviourist learning theory extend to the wider school community. Daniel observed that parents increasingly use the Internet

to “keep in touch with what their students are doing and . . . the expectations placed on them from curricula and co curricula perspectives” (DLTR-4).

In their research, Burton, Moore and Magliaro (2004) expand Behaviourist theory into the four sub-categories of Respondent Learning, Operant Conditioning, Observational Learning and Methodological Behaviourism. The data collected from Daniel were examined for evidence of these variations. There was no evidence of Respondent Learning or Methodological Behaviourism in data collected from Daniel. There was evidence of Operant Conditioning and Observational Learning and this is presented below in Tables 4.28 and 4.29 respectively.

4.1.2.1.1 Operant Conditioning

Operant Conditioning is characterised by the ‘cue-operand-consequence’ sequence identified by Burton, Moore and Magliaro (2004). They also identify the following three categories of operant conditioning: complex learning; problem solving; and transfer.

- Complex learning from Burton et al, involves monitoring the consequences of a learning activity, and repeating the cues in a feedback loop known as “schedules of reinforcement” (p. 11). This sequence is evident in Daniel’s descriptions of students’ behaviours in the simulated business environment where a particular learning outcome requires a student to demonstrate a technical skill in the use of a software tool, Table 4.28 below.
- Problem solving strategies are developed by providing what Burton et al characterize as “trial and error experiences” . . . [which require learners to make] . . . “tactical readjustment to changes in the environment” (p. 12). Daniel describes this type of learning experience in VCE ICT activities where his students are selecting and adapting program coding to control robots, Table 4.28 below.
- Transfer from Burton et al “involves the replication of identical behaviours from [one] task . . . to a new task that has similar elements” (p. 12). Daniel’s descriptions of his students applying knowledge of the relationship between mega-pixels and image quality provide examples of the transfer process, Table 4.28 below.

The examples cited in Table 4.28 were selected as typical of the three categories identified by Burton et al that were found in the tutorials described by Daniel, see Table 4.28 below.

Table 4.28 Daniel: The Antecedents (cues or signals), Operands Consequences Sequence

Features of Operant Conditioning Burton, Moore and Magliaro (2004) expected in instructional material	Features in Daniels's Descriptions of Online Learning Activities Daniel Observed
Complex Learning: "Chained behaviours . . . the consequence [of one learning step] takes on a dual role and becomes the stimulus [for the next step] . . . relying on the learner building associations based on the simplest unit they have learned in an environment which provides contiguity and utilizes repetition" (p. 12).	""Yes, there's all of this, many different tools used in this and I try to explain them as we go. And if you notice, there's no gap in the clouds and there's actually another sun, so it's brighter in the photo. Then I'm making the background completely grey but the sun's still bright and then I take it a bit further and I say, "Right, this is my portrait and there's a fern garden behind me and there's actually a sunset," so there's two layers in the background to give that sort of golden colour in the ferns. And again, these are where I'm zooming in and just getting rid of the superfluous colours there" (DTran-882).
Problem Solving: "Tactical readjustment to changes in the environment . . . [a] trial and error experience . . . controlling the sequence of material, monitoring the student's progress and providing appropriate help results in the learners ability to generalize (respond the same way to similar stimuli) and discriminate (respond differently to varied stimuli)"(p. 12).	"They want to get there and hack away. And I've got a team of kids who do Year 10, a Robotics course. And once again you're getting them to basically build the robots, get a program, and they're learning by looking at programs and then adding to them and changing them" (DTran-124).
Transfer : "Involves the replication of identical behaviours from [one] task . . . to a new task that has similar elements" (p. 12). "Discriminate and to generalize . . . central in the processes that enable learning to be adapted and transferred to other "environments (p. 12).	Explaining how students use a skill they have learned, "They have to take a digital shot of a sufficient quality . . . sort of almost 20MB inside Photoshop, so it'll be maybe seven mega-pixels and you bring it in at seven and you put it in Photoshop " (DTran-845).

Burton et al further state that control of the sequencing of material and monitoring students' progress so as to provide appropriate help "results in the learner's ability to generalize (respond the same way to similar stimuli) and discriminate (respond differently to varied stimuli)" (p.12). Daniel's descriptions of his interactions with his students show that he is making judgments about how the material is paced and sequenced and that unlike methodological behaviourism it is not automated by computer programming.

4.1.2.1.2 Observational Learning

The other sub-category of Behaviourist Learning Theory evident in the data collected from Daniel is Observational learning. This is based on the idea that new behaviour can be learned by observing the behaviour of others. Burton, Moore and Magliaro (2004) note this is also known as *vicarious* learning and derives from Social Learning Theory where learners observe “other people’s behaviour and its consequences for them.” (p. 12).

Daniel's descriptions of students’ role-playing in simulated business environments demonstrate the four components of observational learning: attention; retention; motor reproduction and motivation.

- Attention, from Burton et al, refers to the learner’s/observer’s sensory capacity, their ability to observe complexity and make judgments about value. In the examples, Daniel expects students to observe greater and greater detail and use specified tools to make finer and finer adjustments.
- Retention, from Burton et al, refers to the patterns and symbols used to organise what is remembered, how they are imagined and verbalized. In the examples shown in Table 4.29, Daniel expects students to apply techniques learned on one task to a slightly different task.
- Motor reproduction, from Burton et al, refers to the organisation of responses on the basis of feedback, practising behaviours, following cues and making corrective adjustments. In the examples in Table 4.29, Daniel’s students practice using tablets and learning and correcting as they work.
- Motivation, from Burton et al, refers to the judgments learners make about what they have learned, valued behaviours are adapted and distasteful behaviours avoided. In the examples in Table 4.29, Daniel’s students have to choose a scenario and then apply specified techniques to design and create an information product that meets design criteria.

Daniel’s descriptions of his interactions with his students and the processes he followed in a number of learning activities, provide examples of attention, retention, motor reproduction and motivation. These are set out in Table 4.29 below.

Table 4.29 Daniel: Components of Observational Learning

Features of Observational Learning Burton, Moore and Magliaro (2004) expected in instructional material	Features of Observational Learning described by Daniel
<p><u>Attention</u> “observers sensory capacity” (p. 12). “Learners should be told why they should take a lesson so that they can attend to the information throughout the lesson” links to both simpler and more complex material can be used to accommodate learners at different knowledge levels” (p. 11).</p>	<p>“Then of course you have to get to higher level in order to get them to produce the ads and get them to a standard where they might be able to do that I’m going to change the clouds in the picture. It doesn’t matter what picture it is it could be a portrait or anything. So you remove that and you can trim around the edges and we go in and zoom and show them how to do that” (DTran-873).</p>
<p><u>Retention</u> “Response patterns and how they are represented in memory in symbolic form” (p. 12).</p>	<p>“And so that’s what they have to do for the pop art one and they haven’t got rid of the background here, so then you’ve got a different one where you do, that involves like a couple of masking techniques and layering and so on” (DTran-871).</p>
<p><u>Motor reproduction</u> “Organisation of responses on the basis of feedback” (p. 12).</p>	<p>Daniel discussing examples of learning activities “It’s actually a filter inside Photoshop. But anyway, so you get rid of the colour and then you’re basically colouring over it and you’re zooming and you’re doing layers and you’re layering in and colouring but with the tablet so you can see how the tablet’s particularly useful and then this is a different version and then you end up with . . . that’s a previous one I did” (DTran-867).</p>
<p><u>Motivation</u> “Evaluative judgments that learners make about what they have learned and how it will affect their performance” (p. 12).</p>	<p>Daniel pointing to examples of particular skills “That’s right and then we take that and we do this poster for the design task. So they’ve done their Photoshop stuff, they also do the digital camera scanning, but that’s pretty straightforward. And then we go into the design process, and they have to make the advertising part and so I give them basically a case study of two businesses, Shark Bay Game Fishing and Hollywood Shoes, they’re just things I made up of course, or another business of their choosing like a home business and these are the critical elements they have to put in their poster like layers and text and so on and follow the design process in five stages.” (DTran-909).</p>

In summary, the instructional material and online learning environments described by Daniel exhibit features Ally expected to be found in an online environment based on Behaviourist Learning Theory. The activities provide what Burton, Moore and Magliaro characterize as opportunities to promote Operant Conditioning, the components of which are: complex learning, problem solving and the capacity to transfer learned skills and knowledge to new situations. The data also indicate that role-playing in simulated business environments exhibit features that Burton et al associates with Observational learning, namely: attention, retention, motor reproduction and motivation.

In the next section, artifacts collected from Daniel, and his comments in the transcripts of interview, are examined for evidence of online instructional material Ally associated with Cognitive Learning Theory (CPLT).

4.6.2.2 Cognitive

Cognitive Psychology Learning Theory (CPLT) discussed in Chapter 2, Review of Literature is identified by Ally (2004) as internal learning processes involving the use of memory, motivation, thinking and reflection. He concludes that instructional material designed for online learning which utilised CPLT exhibits the identifiable features set out in Table 4.30 below. They are matched with examples from Daniel's descriptions of the online learning activities used in his classrooms.

Table 4.30 Daniel: Features of CPLT Observed in Online Learning Material

Features Ally (2004) expected in online learning material based on the CPLT	Examples of online learning activities Daniel described in the transcript of interview and in the Learning Technology Report.
Information carefully coloured, placed and paced to assist them perceive and transfer it to working memory	When students use Microsoft FrontPage for coding activities the font colour changes according to the syntax of the programming language. This helps students writing programs to understand the syntax of HTML tags and various other programming constructs. Figure 5.1
Information . . . grouped into generalized categories using information maps.	The webbing feature of Inspiration software "shows how different categories of information relate to one another. Brainstorming method that provides structure for ideas and facts" www.inspiration.com . For Daniel, "Inspiration software is used to build better logic in argument and essays (DLTR-. 22)
Help learners construct a link between information in long term memory and new information	The visual learning feature of Inspiration software builds on the notion that "learning is better understood . . . and relevant when ideas, words and concepts are associated with images" www.inspiration.com .
Require learners to apply, analyse, synthesize and evaluate information	"Oh, we're going to do cool things like we pretend we're in a workplace and we're making a real ad and we're making an A3 ad poster and we're then going to do a webpage for the business," and they're working in a team and they really like that sort of stuff" (DTran-817).
Materials . . . to suit various learning styles	"I've got students from the Deaf School so I had a whole lot of YouTube stuff and I couldn't use it because there's no audio and I had an audio unit I was doing. I can't do that, so I had to pull these elements out of my courses, and then I had to basically make into text the YouTube videos and do these sequences for them and I've done another one for Dreamweaver as well" (DTran-958).
"Support materials . . . appropriate to the learner's preferred style	"Well yes, and in Year 8, they're on WebCT (Blackboard) and they're getting their Dreamweaver assignments and stuff, so we print as little as we possibly can. . . . [YouTube provides video visual and auditory]" (DTran-351)
"Learning material . . . constructed to motivate learners	"That's what we would try to do and that's what they see as relevant too, because they hear and see what technicians do out in the field and that's what they're wanting to be like and act like" (DTran-131).

Figure 5.1 below is an example of an online coding activity created by K.Thatcher using Microsoft FrontPage where colour and placement are used to help students understand and remember the syntax and logic of computer programs. Daniel refers to this software and other computer coding software which also use the colour and placement Ally expected to be found in online instructional material based on CPLT.

```
<script language = "JavaScript">

//SETUP THE ARRAY OF USERS
var username = Array(3);

//ENTERING STRING VARIABLES

username[1] = new Array("jack");
username[2] = new Array("kim");
username[3] = new Array("giorgio");

var locked = true;

//ASK THE USER FOR A LOGIN NAME
var login = prompt("Enter your user

//TEST LOGIN NAME AGAINST REGISTERE

if((login == "jack") || (login ==
locked = false;
```

Fig 5.1 Coding Activity Using Microsoft FrontPage Created by K.Thatcher

In summary, the online instructional materials Daniel provided for his ICT classes exhibit all the features Ally expected to be found in online material based on CPLT. In the next section, the data collected from Daniel is examined for evidence of features Ally associates with a Constructivist learning environment.

4.6.2.3 Constructivist

Constructivist Learning Theory is discussed in Chapter 2, Review of Literature. From Ally (2004) this theory contends that “learners learn best when they can contextualize what they learn for immediate application and when they learn to acquire personal meaning” (p. 7). These are set out in Table 4.31 below. They are matched with examples from Daniel’s descriptions of the online learning environment in his classrooms and stated in the LTR.

Table 4.31 Daniel: Features of Constructivist Observed in Online Learning Material Ally

Features Ally (2004) expected in a Learning Environment Based on Constructivist Learning Theory	Features Found in Daniel's Descriptions of the Online Learning Environment
Strategies to make learning an active process" (p. 18).	"But again, the network theory is incorporated into us actually doing it so, "You install this operating system now on a particular network and I'll bring a router in and connect," and so it's very much a, as you would learn on the job, I think" (DTran-135).
Opportunities for "learners to construct their own knowledge" (p. 19).	"And so let's put it in a loop and they put it in a loop. There's another team of kids who would by their own bat, have decided they're designing a game and they've designed a little project team and there's one doing is PHP programming and there's others doing the 3D graphics and they're putting together the package and I've set up a network" (DTran-131).
An environment that "encourages collaborative learning is promoted" (p.19)	"Well, it is. I think they're enjoyable things and they're learning some of working in a project team" (DTran-170).

Examples of Constructivist learning theory are also found in the Learning Technology Report (DLTR) where Daniel sets out the advantages of a multi-user computer simulation called *Second Life*. It is a virtual environment which Carter and Click (2006) describe as a "three dimensional world . . . created by its residents who are physically located around the world" (p.1). He states that Second Life allows teachers in all subject areas to simulate contexts so that "learners can visit places too dangerous or impossible to visit in real life" (DLTR-1). All three features that Ally expected in a Constructivist learning environment are facilitated in simulated worlds described in promotional material as worlds where:

- Students and teachers can visit virtual gothic cathedrals, cities, museums and libraries as part of an active learning process;
- Learners have the opportunity to construct their own knowledge and teachers the chance to frame the learning outcomes within 'realistic' and safe experiences;
- There is the opportunity for collaborative learning.

In the next section 4.6.3 the artifacts, observations and comments by Daniel are further examined for advantages Ally (2004) believes the Internet brings to learning.

4.6.3 Education and the Internet

For Daniel the Internet rings two major advantages to the VCE ICT learning environment

- real-time access to online resources and expertise*

ii. a range of online collaboration tools for business and social communication

With respect to the first advantage, the Internet enables a close emulation of business environments, which Daniel believes enhances the teaching of VCE ICT. In his classroom he creates an online environment where students make use of instant access to industry standard communication technology, manuals and specifications. In a general statement he hoped that schools would follow the example of business and “encourage the use of PDAs, mobile phones and social media ...” (DTLR-25).

With respect to the second advantage, the Internet is an important factor in the uptake of email, WIKIs, Blogs, social media, YouTube, and the virtual experiences offered by Second Life. He observed that YouTube is used widely by teachers and students and he aims to make it a centralised resource using screen sharing software. By this means students will be able to promptly search for information on a “centralized display” (DTLR-8). Daniel promotes the use of YouTube because the instruction is individualized, and in small video format, which suits many small mobile devices.

Daniel believes the Internet in combination with the widespread acceptance and experience of tablets and mobile phones is leading to the greater incidence of learning by social networking. He notes that “filming, editing and uploading digital video to YouTube seems a comparatively simple task for young secondary students . . .” (DTLR-17). For Daniel the move towards an online curriculum was led by a view amongst students “that learning technology . . . computer software generally and digital hardware is an implicit part of their lives. They see a need and implement the correct tool without much thought at all . . .” (DTLR-17). He hoped that the curriculum could “adapt to using technology to supplement or enrich the learning environment” (DTLR-25).

4.7 Case Louise

Louise is the Information Manager at a large independent secondary college in Victoria and a well known commentator on and author of online ICT learning and assessment material for the VCE. At the time of the interview she was teaching a Year 12 VCE Software Development class where the focus was on programming applications for a networked environment. At the beginning of the interview Louise established a framework for her responses with the statement, “Right so you’re looking at classrooms that you would have normally as face to face, but you also provide them with some sort of online learning environment” (LTran-11).

Louise commenced with a brief overview of the college's management structure, explaining that the College Council had recently separated the administration of ICT technical services from the administration of ICT curriculum. A Head of Information Services had been appointed to oversee the purchase and maintenance of all computer hardware and software. Louise described the role as “high ranking in the school’s admin area . . . on the executive . . . [and having] as much power as the Head of Curriculum” (LTran-570). She was pleased that the new appointee had very quickly used the school’s intranet-based email system to set up an “IT help system . . . so that you can . . . write your question and the right person then responds to you” (LTran-608). In her view, a reliable ICT support team is essential because “every teaching space has a data projector” (LTran-608), and most teachers use “PowerPoint instead of writing on the board” (LTran-33). This is possible because a recent upgrade to all classrooms had resulted in the purchase of “\$500,000 worth of data projectors” (LTran-622).

Louise characterised the attitude of the college's administration as “forward thinking” (LTran-1286), explaining that detailed policies were in place for students, teachers, and technology. She cited as examples: all students must have laptop computers; teachers in the Year 10 program “must have something online in every course” (LTran-638); all blackboards had been replaced by whiteboards and overhead projectors. She believed that generally, the ICT environment the college had created worked because “the kids . . . have the technology in front of them . . . [and teaching and technical staff] support that . . .” (LTran-638). Further, that providing a standard ICT environment resulted in most teachers providing students with curriculum material and feedback via the school intranet.

With respect to teachers using technology across the college, Louise believed that while all teachers met the minimum requirements, the uptake of truly interactive technology had “been relatively minimal . . . [mostly] a version of Word documents, PowerPoint documents . . . [and the result was usually] a very static document . . .” (LTran-22). She reflected that most teachers “demanded a printed version of what the student has done” (LTran-313) and believed that was because it was their own experience of using computers. She surmised that their thinking was “I’ve moved ahead by allowing them to type it, I’ve moved ahead by putting it on PowerPoint . . . what else do you want me to do?” (LTran-319). In her experience many teachers did not believe “it was about changing their teaching and learning style . . . it was about changing their delivery style” (LTran-319).

Louise explained that the situation with respect to professional development was reflected in the priority given to supporting the policy that mandates all handouts to students be available online. To this end the professional development available was limited to “how you might do it another way, or a limited demonstration of what a real online environment might be . . . like an electronic text book or . . . the five worksheets that you handed out are all available online . . .” (LTran-32). In her experience, moving to a curriculum based on interactive technology had involved a complex interplay between teaching and technology. At the time of interview, this type of change had not been addressed in the college's formal professional development program, but there were many instances of individual teachers utilizing ICT in innovative ways.

Louise observed that some science teachers, for example, wanted to video their practical demonstrations of scientific experiments and make them available to students as podcasts. She believed the idea had merit because students liked to be able to review the procedures when writing their reports or doing homework. But she thought that in the long run commercially available videos would serve the same purpose, because of the time it took for the teacher to select the content, work out the best sequence and produce a video of sufficient quality. For her own classes she could prepare material in 5 minutes, compared to the “4 hours to do a podcast of every lesson” (LTran-342). She stated that it was worthwhile for some topics, exam technique, for example, where the message “holds true . . . this year or 3 years down the track” (LTran-1156).

For students, the use of online material was double-edged. On the one hand, they didn't have to take notes because they had laptops and all class notes were available on line. Some students go so far as to believe they “don’t need a teacher . . . because the worksheet is already there . . .”

(LTran-32). On the other hand, the laptops are not the best available and students “get frustrated . . . are very negative towards . . . [Government sponsored brand of laptop]” (LTran-328). She observed that on balance, students would rather be online than not, and that they tolerated the situation with patience.

Louise expressed her own frustration with the college's policy towards students' access to the Internet. She considered the tension between the educational benefits of allowing students free access to the Internet, and protecting them from its dangers, was an increasing problem for the administrators of the college. For her, the choice of software came down to whether the teachers should use Open source software or branded software, like Microsoft. She explained that for those charged with administering ICT in the school this choice was a matter of security. From the perspective of the technical support staff, “any . . . pieces of software or systems that are Open Source, that require less security on a network, . . .[and] your services people go no” (LTran-740). She believed that ultimately, getting the right environment for teaching was similar to the situation businesses face, and ultimately, came down to trusting the technology support staff.

I support their [technology support staff] actions and I work with them, our kids find it very negative and I try and be the balance between those two, and be rational about why we might be doing something or not doing something. The kids don't realize that once they actually get to a corporate environment . . . that what they're getting is pretty much similar to that (LTran671).

Louise declared that while she gets frustrated with the fact that other people control the technology teachers use, ultimately she did not “care about the technology . . . [or] who puts it in place . . .[or] who controls it, as long as they allow me to do the things I want to be able to do” (LTran-721). For her, there was less of a problem at Year 10 “because we have an ability to be more flexible about our delivery” (LTran-945). She was more restricted at Year 12 “because of the content we're trying to teach and the exam we're working towards” (LTran-945).

4.7.1 Emergent Themes

When the data were examined for emergent themes, the following two major themes were identified: infrastructure to support the technology; finding resources to support a variety of learning styles.

i. First emergent theme: infrastructure to support the technology.

The college's support for an online curriculum was evidenced in the following suite of achievable objectives to enhance a college-wide ICT environment. First, every classroom was equipped with a whiteboard and overhead projector. The school's ICT policy Louise stated, was based on the belief that "if you put everything on PowerPoint, and dump it online, then you're somehow being better than you were if you were writing it on the board" (LTran-71). She declared that while she did not necessarily believe that using the college intranet to access class notes and submit homework was "doing new age technology" (LTran-71), many students and teachers did. Secondly, all Year 10 curriculum documents had to be online by the beginning of the following year. This was a modest aim based on a belief that teachers, at the very least, could create Word documents and PowerPoint slides. Thirdly, the intranet and laptop programs were supported by a well organised team of ICT support staff. This group was expected to implement and maintain the technologies for the curriculum programs, and "make sure that it works" (LTran-295). For her own VCE requirements she was looking at sitting down with support staff and saying, "Okay, for my Software Development class next year, I need to have all of these things active and going from day one so that I can communicate with these kids from home"(LTran-295).

ii. Second emergent theme: finding resources to support a variety of learning styles.

Louise was aware of the need to cater for various learning styles. In her Year 12 VCE Software Development class, for example, she collated a list "of current websites . . . to support their learning . . . animations for Visual Basic or whatever it might be" (LTran-251). In the following year her Year 12 VCE class was to be timetabled in a four hour block in the afternoon. She anticipated that a class of that duration would not work well for students unless she could "model some behaviour . . . where I can also then link . . . online resources" (LTran-238). Louise believed that her students were ready to use a wider range of online learning material because they were already using Blogs, WIKIs, email, YouTube and social media outside school.

Themes discussed in this section derive from data collected from Louise. In the next section theoretical considerations discussed in the Review of Literature, Chapter 2 are used to examine her comments during an interview, the artifacts collected from her, and field notes made by the researcher.

4.7.2 Theoretical Framework

Louise's responses were read for examples of observable features Ally (2004) expected to be found in learning environments or instructional material based on one of three major learning theories. The results are presented under the headings of these learning theories: Behaviourist; Cognitive and Constructivist.

4.7.2.1 Behaviourist

Behaviourist theory, discussed in the Review of Literature, Chapter 2 is identified by Ally (2004) as producing "observable behaviour that indicates whether or not the learner has learned something" (p. 7). The examples of online instructional materials created by Louise that illustrate the features Ally associated with Behaviourist theory are presented in Table 4.32 below.

Table 4.32 Louise: Features of Behaviourist Theory

Features of Behaviourist Theory Ally (2004) expected in online instructional material	Online Templates for Assessment Activities Provided by Louise for her VCE Software Development class on the School Intranet and the ICT Teachers Email List .
"Learners are informed of learning expectations so they can assess their own performance" (p. 7).	The Software Requirements Specifications template (Figure 5.2), created by K.Thatcher following Louise's advice to teachers, illustrates how students are to complete the task, The headings inform learners of content expectations and the format provides a framework that helps them meet the standard of presentation required.
"Testing is integrated into learning experience to ascertain achievement and provide feedback" (p. 7).	In the example of a template for the completion of <i>Unit 3 Outcome 1 Assessment</i> , "tasks must be part of the regular teaching and learning program . . . not add unduly to the workload associated with the program. . . be completed in class and within a limited timeframe" (p. 43) VCAA (2010).
"Material is sequenced usually from simple to complex, to promote learning" (p. 7).	In the example of Software Requirements Specifications created by K.Thatcher headings for a report of an analysis are provided. Louise has advised teachers to group, then sequenced the headings from simple to complex. (Figure 5.2)
"Feedback allows learners to monitor their own progress and determine an action" (p. 7).	In the example of a <i>Unit 3 Network Test</i> Louise posted sample answers to past assessment activities on the school intranet and the teachers email list This and other posts by Louise include advice and links to websites for more in-depth content information.

Louise posted a compilation of resources for assessment activities on the VCE Software Development teachers' email list, and on her school's intranet. These illustrate the four features of Behaviourist Theory Ally (2004) expected in online instructional material. First learners are informed of what is expected. Secondly, the assessment task is completed as a normal part of teaching and learning. Thirdly, the template headings are sequenced from simple to complex. In the examples posted, students start with a relatively straightforward description and can use the Internet to search for technical details of network hardware. The process of finding an answer

leads to increasing confidence in their ability to use the resources of the Internet to find answers to more complex questions. Fourthly, for each sample test there is a sample solution and by this means learners are provided with feedback that allows each to monitor his/her own progress and determine an action.

The template for a Software Requirements Specification shown in Figure 5.2 below, is an example of providing the headings and format for an assessment task that students must complete as part of the Year 12 VCE Software Development study.

Software Requirement Specification – Mountain Sports Club
1. Introduction
✦ <u>1.1 Purpose</u>
2. Scope
✦ <u>2.1 Items within Scope</u>
✦ <u>2.2 Items not in Scope</u>
✦ <u>2.3 Operating Environment</u>
3. Functional Requirements
✦ <u>3.1 Functional Requirements</u>
4. Non-Functional Requirements
5. Constraints

Figure 5.2 Template for VCE Software Development Learning Outcome 2 created by K.Thatcher

As discussed in the Review of Literature Chapter 2, Burton, Moore and Magliaro (2004) expand Behaviourist theory into the four sub-categories of respondent learning, operant conditioning, observational learning and methodological behaviourism. The advice for templates and activities posted and described by Louise were examined for features associated with these four sub-categories, and strongly evidence only features associated with the sub-category Observational learning.

4.7.2.1.1 Observational Learning

Observational learning is a sub-category of Behaviourist Theory, based on the idea that new behaviour can be learned by observing the behaviour of others. Burton et al (2004) note this is also known as vicarious learning and derives from Social Learning Theory where learners observe “other people’s behaviour and its consequences for them.” (p. 12). Louise’s descriptions

of online video tutorials she uses in her computer classrooms evidence the attention, retention, motor reproduction and motivation features of Observational learning. The examples taken from the data are presented in Table 4.33 below to illustrate the components of Observational learning.

Table 4.33 Louise: Components of Observational Learning

Features of Observational Learning Burton, Moore and Magliaro (2004) expected in instructional material	Features of Observational learning described by Louise
<p><u>Attention:</u> Observers sensory capacity (perceptual set) “Learners should be told why they should take a lesson so that they can attend to the information throughout the lesson” links to both simpler and more complex material can be used to accommodate learners at different knowledge levels” (p. 11).</p>	<p>Louise, commenting on the process of teaching students how to look for greater and greater detail “someone actually had the question on screen and was pointing out particular bits . . . you do need the video version of it so that they can have it on their iPod . . . where they can actually listen and see what someone’s pointing out, see this word, this actually meant this, that you needed to do this and this is the style of answer” (LTran-397).</p>
<p><u>Retention:</u> “Response patterns and how they are represented in memory in symbolic form” (p. 11).</p>	<p>Louise, commenting on using video tutorials to aid retention, “It reinforced learning, it didn’t teach the content, we had already done the content, it was . . . random multiple choice for a particular network . . . things [that] just reinforce what they know”(LTran-258), and “I don’t sit there and read from it . . . their revision has come from that material and I have directed them to a range of resources online that support whatever they’re reading because the text book is static . . . it doesn’t tell them what’s happening now” (LTran-147).</p>
<p><u>Motor reproduction:</u> “Organisation of responses on the basis of feedback” (p. 11).</p>	<p>Louise, commenting on videoing science practical classes and posting them online to provide feedback, "They might still do the prac as per normal but in terms of revision of that, or re-looking at the skills required or if they needed to write a prac report and wanted to go back and review it they might do it that way" (LTran-51) and not "have to go to a video, they just click a button online"(LTran-43).</p>
<p><u>Motivation:</u> “evaluative judgments that learners make about what they have learned and how it will affect their performance” (p. 11).</p>	<p>Louise, commenting on the relationship between access to online notes and motivation, “I’ve spoken to ex-students who’ve said ‘well I don’t have to go to my lectures anymore because I just pull out and read it’ . . . that’s not necessarily a change in education, it’s just a change . . . Whether that makes those kids . . . have any better learning outcome, I don’t believe it does, . . . here’s a written transcript of that lecture that you missed rather than having to go and see someone or talk to someone or do anything else” (LTran-957).</p>

Features of Observational learning are found in Louise's use of video tutorials and in her ideas about using video recordings of practical classes. The attention feature is illustrated in learning

material designed to engage students' sensory capacity. Retention is evident in the opportunities online activities provide to repeatedly practice and apply what is learned. Motor reproduction is evident in students' access to feedback which, in turn, fosters the capacity to adjust their behaviour and select a direction for future learning. Motivation is arguably increased by encouraging students to select what suits their particular learning style from a variety of online instructional modes and diverse knowledge sources.

In summary, the online instructional material created by Louise and the learning environment she fosters in her classroom exhibit features Ally (2004) and Burton et al (2004) associate with Behaviourist Learning Theory. According to Ally, it is the online activities that encourage the learner to assess their own performance, monitor their own progress and determine an action. This occurs in the online environment encouraged by Louise because assessment is integrated into the learning experiences and students are provided with standardized templates so that they know what is expected. From Burton et al, it is those activities which encourage students to make evaluative judgments about what they have learned, and make autonomous judgments about the direction their learning should take.

In the next section, artifacts collected from Louise, her comments in the transcript of interview and her postings on the teachers' email list are examined for evidence of online instructional material associated with Cognitive Psychology Learning Theory (CPLT).

4.7.2.2 Cognitive

Cognitive Psychology Learning Theory (CPLT) discussed in the Review of Literature, Chapter 2 is identified by Ally (2004) as internal learning processes involving the use of memory, motivation, thinking and reflection. The examples of online instructional material created by Louise which illustrate those features are presented in Table 4.34 below.

Table 4.34 Louise: Features of CPLT Observed in Online Learning Material

Features Ally (2004) expected in online learning material based on the CPLT	Features Observed in Instructional Material Collected from Louise
Information carefully coloured, placed and paced to assists them perceive and transfer it to working memory.	Louise used coloured headings and images in the online exemplar templates she created to assist her students complete VCE assessment tasks, " Now I have all of my notes on PowerPoint, my summaries . . . and I also teach . . . about getting software that will read the power point to them" (LTran-79).
Information . . . grouped into generalized categories using information maps.	Louise, commenting on the relative value of Use-Case text and diagrams "Students did both . . . if you get the text right . . . you will be able to do the diagram" (advice to teachers Louise posted on the VCE Software Development Teachers email list (LArt -3).
Help learners construct a link between information in long term memory and new information	Louise, commenting on students making decisions about how they learn new information, " If I type up all my notes, the kids also go why are you writing this on the board? Because the kids are beyond writing the text anymore . . . the writing experience for them is not a value. They would rather have it on PowerPoint . . . "(LTran-81).
Require learners to apply, analyse, synthesize and evaluate information.	The advice posted by Louise for a Software Requirements Specifications' template (Figure 5.2) has major sections covering analysis, synthesis and evaluation. This framework sets out the processes and format students are to follow when responding to a case study scenario (LArt-5).
Materials . . . to suit various learning styles.	Louise, commenting on catering for a range of learning styles, "I've used the Microsoft Office, or the Microsoft site, where they actually orally talk you through the demo, on particular software products" (LTrans-417)
Support materials . . . appropriate to the learner's preferred style.	Louise, commenting on using audio, video tutorials and podcasts of her own teaching sessions "So that they can actually, particularly those kids that have reading difficulties, they can sit there and just listen to it"(LTran91), and "I think the confidence of what you produce is of value . . . I can do a better job if I'm standing in front of my class . . . however, I know when it comes to something like exams, if I had a [commercial] video that spoke about the exam at the end of the year, . . . the kids would probably listen to that more than me"(LTran-389).
Learning material . . . constructed to motivate learners.	Louise commenting on referring students to online resources, "And I used one with them earlier in the year that . . . had lots of networking stuff on it, lots of Flash animation and that sort of thing and they found that quite useful" (LTran-255).

The online learning activities Louise posted on the teachers' email list is evidence of information coloured and placed in the way Burton et al describe. Louise in her description of the process required to create quality podcasts, was aware that the sequence and pacing of content influence the effectiveness of instructional material. She explains that "to create effective online learning material . . . you've got to pick and choose the time and content . . ." (LTran-1156), and place the separate items in a particular order.

In summary, the instructional material Louise creates for her Year 12 VCE Software Development class and the learning environments she supports as Information Manager, exhibit all the features Ally and Burton et al expect in an online learning environment based on Cognitive Learning Theory.

In the next section, artifacts collected from Louise, and her statements in the transcript of interview and on the teachers email list were examined for evidence of online instructional material associated with Constructivist Learning Theory (CLT).

4.7.2.3 Constructivist

Constructivist Learning Theory in an online learning environment as discussed by Ally (2004) contends that “learners learn best when they can contextualize what they learn for immediate application and when they learn to acquire personal meaning” (p. 7). Table 4.35 below sets out features Ally expected to be found in a Constructivist learning environment, along with examples to illustrate these collected from Louise.

Table 4.35 Louise: Features of Constructivist Learning Theory Observed in Online Learning Material

Features Ally (2004) expected in a learning Environment based on Constructivist Learning Theory	Features found in Louise’s descriptions of the online Learning environment available for her VCE students
Strategies to make learning an active process.	Commenting on managing an ICT classroom “if they’re on the internet doing something while they’re meant to be doing something else, I don’t care, I say go, go for it” (LTran-979).
Opportunities for learners to construct their own knowledge.	“. . . I must admit the kids within my class that are my natural kids in terms of IT, I’m not teaching them things, I’m not, I’m not being their guide I’m not being their facilitator or the moderator or any of those fancy words that we all now use, they’re just there and they will do and they will lead and they will take and they will shape and they will do all those things without me”(LTran-1341).
An environment that encourages collaborative learning is promoted.	“. . . I will probably use one of my class times to actually say . . . we’re all going to be online around this time, so if you want to chat about . . . because you no longer have that time to build the rapport that you would have if you were then doing a teacher directed class, so trying to use another technology to actually build that up” (LTran-206).

Louise’s descriptions indicate that in the process of encouraging online collaborative learning, she provides opportunities for students to create their own knowledge. Her comments also suggest that she is constrained by what she sees as the college’s understandably conservative approach to adopting online social media as a learning environment.

With respect to collaboration, Louise believes that the technology the school uses has “lots of positives but it also . . . [has] lots of negatives” (LTran-1088). The level of security on the school intranet, for example, means online learning activities have to be planned and well structured. But despite very rigorous planning, the level of control is still such that only teachers can access “YouTube” (LTran-1033). She reports facing similar problems trying to build collaborative learning activities using FaceBook and the MySpace. She solved that problem by asking students to use false identities. In the following year she hoped to be able to “run a Blog and a WIKI . . .” (LTran-833), and address an additional problem arising from the college administration’s request that chat sites created for class discussions utilize the college’s intranet rather than the Internet. The administration’s policy was typified in the further request, that teachers not make statements as teachers that are “external to our intranet” (LTran-887).

Louise explained that the assessment requirements of the VCE curriculum reduced the capacity to create an online learning environment where students could freely pursue their own their own interests. The formative and summative outcome statements in the *Information Technology VCE Study Design* VCAA (2006a) demand that she keeps the learning focused on the designated key knowledge points that are examined. In her Year 12 Software Development class, for example, many situations arise “where we’re going to have a 50 minute [online] discussion . . . that’s all worthwhile, but ultimately, at some point, I’ve got to bring it back to something else that works with what we’re doing” (LTran-238).

In summary, Louise’s aims to create an online learning environment utilising the features Burton et al associate with Constructivist Learning theory, but she is constrained by the need to cover the specified learning outcomes. In the next section 4.7.3 the artifacts, observations and comments by Louise are further examined for evidence of advantages brought by the Internet.

4.7.3 Education and the Internet

For Louise, the Internet offered:

- i. *Access to resources to suit various learning styles*
- ii. *An opportunity to model various teaching styles*
- iii. *A natural environment for teachers who were digital natives*

i Access to resources to suit various learning styles

The data collected from Louise indicated that her aim was to use the Internet and all of its formal and informal instructional formats as resources to suit a range of learning styles. She described using forums, chat rooms and YouTube to provide both individual instruction and a collaborative learning environment for her Year 12 VCE Software Development class. To this end, Louise utilised the ICT teachers' email list to post templates for the four assessment tasks that Software Development students were expected to complete in class. She also posted collations of past examination questions that these students could use as practice for the end of year examination. In her own class she was always looking for alternative teaching strategies, stating that “in the next year . . . I will be looking at other ways of delivering it [the material]” (LTran-177).

ii An opportunity to model various teaching styles

Throughout the interview Louise spoke of modelling behaviours where she could “link in . . . online resources (LTran-244). Her aim was to direct students to a range of online learning activities and let them choose those that suited their needs. She did not want to stand up and lecture, she wanted to have conversations with students and be able to say, “Go here with it” (LTran-1359). As discussed earlier, the college had conservative policies in place to deal with any cyber issues associated with mobile phone and instant messaging, and while she found these restricted her efforts to use chat sites, WIKIs and YouTube, she was prepared to deal with these and keep trialling new initiatives.

iii A natural environment for teachers who are digital natives

To conclude, Louise observed that many young teachers had natural ICT skills, and they bring an expectation to their teaching that the classroom will operate as a collective. She explained that she can model the behaviour of these younger teachers, but she knows it is not “a natural part of . . . [her] teaching style” (LTran-1226). In general, she noted that schools do not keep these digital natives. “Our young staff last 5 years and then they go off and do something else . . . You've got 5 years to try and move that natural model to everyone else . . .” (LTran-1315). She accepted that for some teachers, especially those who had been at the school for 25 years, adopting collaborative teaching practices was “never going to happen” (LTran-1315). At the same time, she hoped that some teachers would experiment with teaching in a collaborative way and by that experience, gradually learn new teaching practices.

4.8 Case Robert

Robert is the Technology Development Manager at a large secondary college in Victoria. He is a well known presenter of professional development activities for teachers interested in developing and using interactive whiteboard technology. At the time of the interview he was teaching a Year 12 VCE English class and a Year 10 English class. He characterised his role “as more realistically . . . Intranet Development Manager” (RTran-86), explaining as the interview progressed, how the college had gradually developed its intranet to deliver online resources into every classroom.

Robert believed that the college had always encouraged teachers to create online resources, at one stage, funding highly qualified learning technology coaches to help teachers “create a link in raw HTML on the page [they wanted to upload]” (RTran-86). Robert recalled that using these online resources in the classroom was very difficult. They were slow to access, and as a consequence, the teachers were reluctant to use them. The change in teachers’ attitudes came when the college moved to a simpler database structure. This allowed teachers “to fill in a web form . . . (RTran-86), and see the resource that they had created, immediately available online.

Since that breakthrough, Robert had observed most teachers creating and using online learning material. “The vast majority of resources . . . that our staff are building, are simple office documents” (RTran-86). Many teachers, for example, use Microsoft Word to upload their complete course outlines annotated with explanations of what they are doing. A small group of teachers are looking at programs like DigiLearn (Appendix G), a Victorian Government resource development project, with a view to “creating actual interactive online resources” (RTran-86). He described DigiLearn activities, as incredible, and was disappointed that initially, more teachers were not interested in using it.

Robert believed that an interactive learning environment would come as the number of newly graduating teachers coming into the school increased. He explained that in the previous year “20 . . . brand new teachers” (RTran-119) had joined the staff and were “very excited about using online resources because they’d been using them at teachers college” (RTran-122). He had, for example, built an online discussion board which he called a Class Log or Clog, and was very pleased that a number of the newly arrived graduate teachers were using it with enthusiasm.

To get an intranet operating as a useful resource, the college’s administration had originally

entered into an arrangement with a private company to provide a Virtual Private Network (VPN). The administration's aim was to help teachers construct an online environment where "students can continue or extend their learning outside of the classroom" (RTran-135). When the intranet was first up and running it was judged a success by the school community because students could "get Word at home" (RTran-140). The introduction of laptops for students and interactive whiteboards in classrooms had prompted the next advance, which was towards an interactive environment. Robert noted that many teachers realized at this stage, that they could "use this [networked laptop] for so much more than just typing out handouts" (RTran-226). At the same time, the company contracted to create the VPN realized that just providing a VPN was not enough. They developed a strategy together with the college administration to 'add value to the project'. As part of the strategy, the company employed designers and programmers to work with teachers to create online learning activities using Flash animation software. He explained that the process did not work because subject teachers had to communicate an entire body of knowledge to the program designers, and in practice "it wasn't a good synergy" (RTran-239).

Robert had come to realize that as the technology evolved, more and more teachers were using online interactive learning activities. They were adapting and/or creating digital resources for their own use. Robert had reached the stage where he was asking teachers to let him take "things back off of their hard books and thumb drives and [load them] . . . onto the system" (RTran-588). He pointed to the display on an interactive whiteboard of one year level's learning activities, stating, "As you can see, there are 76 things in here" (RTran-590). There were, he commented, so many resources that some teachers were complaining: "Oh it's just too hard. There's 76 things, kids can't find them" (RTran-591). His ongoing task was to make the teacher-created resources readily accessible to the school community.

Robert was also involved in the development of the Ultranet, an online resource for teachers, parents and students, similar to the one operating at his college, but sponsored by the Victorian State Government and planned to operate at a state-wide level. As a member of the Ultranet Reference Group he explained that the roll-out had been slower than planned, but he was optimistic that the professional development element, at least, would soon be operating. He explained that this would present teachers with a list of professional learning activities from which they can browse, select their choice and then click to enrol. While he believed this feature was worthwhile for teachers in their professional practice and it helped the Government in "tracking a PD" (RTran-1142), he had hoped that, the Ultranet would fulfil its initial objective and bring interactivity to every classroom.

In summary, he saw similarities in the development of his college's intranet and the state-

wide Ultranet. Just as the Government continued to add new features to the Ultranet, he believed that as the college intranet's management of curriculum information improved "we will continue to build hard bits and pieces around it" (Rtan-1115).

In the next section, artifacts collected from Robert, observations of the college's intranet, and his comments in the transcript of interview are examined for emergent themes.

4.8.1 Emergent Themes

When the interview transcript, artifacts and field notes were examined by the researcher the following two preliminary themes emerged: Making access to online resources easier and Online feedback.

i First emergent theme: Making access to online resources easier

The college's intranet provides access to the highly structured online curriculum found on the curriculum authority's VCAA website www.vcaa.vic.gov.au. This includes VCE course outlines, learning outcomes, key knowledge points and assessment rubrics. Robert believed that the college had to find the right structure for the resources that teachers loaded onto the school intranet, so that students could utilize all the online information provided by the curriculum to their advantage.

An initial attempt to develop an information framework for teacher-created resources started with a concept based on unit planners and information flows. Robert remembered that the design for this early structure involved, "You . . . fill out this and . . . It will flow down onto this and then go across there . . . have references over here, the essentials of learning, teaching practices" (RTran-714). When it was developed and trialled "it was unusable, so the teachers wouldn't use it" (RTran-719). The second attempt to develop the information framework was built "entirely on the fly . . . [and] designed . . . so it would be very simple" (RTran-705). Robert characterised this second structure as an online repository of learning activities created by teachers, and "un-scaffolded" (RTran-711). Connecting the formal framework derived from the curriculum authority and the informal repository created by teachers had reached the stage where the two information structures at least work together so that teachers can "create an online item such as a word document or webpage, create a description and link the two to the appropriate learning outcome" (RTran-705).

Robert noted that as teachers gained confidence in using the intranet, two new challenges related to the management of information on the college's intranet, had arisen. First, there

was the need to design the information framework so that a learning activity could be readily identified and accessed. The second challenge arose from teachers' reluctance to remove an online resource once it was in place.

Robert was in the process of solving both of these problems. He explained that mapping the online resource pool created by teachers was complex because an un-scaffolded system worked well for teachers. The process in place made it easy for teachers to create and group online resources but did not fit well with the framework used to manage the formal VCE curriculum derived from the curriculum authority's (VCAA) website www.vcaa.vic.gov.au. In his Year 12 VCE class, for example, he used a "system called Book Boxes. I take five, ten, whatever resources I want and I put them in there and my kids can see those. If they want more they can go hunting for them" (RTran-595). He hoped to develop a "metadata management structure" so that the relationship between the online resources teachers create and the formal course information from the VCAA curriculum authority was clear. "If we don't have a metadata management structure, then it [the unmapped resource pool] just keeps building and building" (RTran-604).

With respect to the second problem, Robert had observed that "teachers always hold on to everything" (RTran-633) and unless the process for removing or updating online resources was simple, much of the information would gradually become outdated. "It's really easy to put things in there but we also need to have a process . . . where they [teachers] can take them out" (RTran-633). In his experience, the process comprised two skills teachers had to learn. One was technically complex and associated with the of removing or editing existing resources. The other was deciding which online resources were outdated and which were not. He thought that the procedures libraries have in place to identify books that are no longer used, for example, might be employed. At the time of the interview, the opportunity for teachers to practise the removal process was made more difficult, because the authority to remove outdated material from the college's intranet was still restricted to a small number of trusted people.

ii Second emergent theme: Online feedback

Throughout the interview, Robert described processes for formal and informal feedback for students, made possible by the intranet. There was a formal process whereby "students . . . evaluate themselves. They . . . give themselves goals, and then they come back intermittently and [say] "Well I've done this and now I'm going to advance here" (RTran-1157). For teachers it involved giving feedback on how they perceive the students "have gone in their

classes, and that then appears on the kid's report" (RTran-1159). The process was based on the idea that students "would be actively thinking about their learning and reflecting upon it" (RTran-1161). He believed the formal feedback and self evaluation process worked only because it was online, and would be unmanageable if it were paper based.

Robert described instances of informal feedback facilitated by the intranet. The first example is an interactive tutorial constructed as a game where students have to explore a diagram of the human skeleton and "Find the humorous . . . click on humorous . . . it gives you little encouragements and feedbacks as you go along" (RTran-336). The second is an online facility called Folio, where students can "open Folio . . . submit their work"(RTran- 693), and receive feedback. The third is a rubric that includes course outlines, key knowledge points and assessment criteria. He noted that the rubric was proving very popular amongst students because in a given assessment task, for example, "They know they've got a five for criterion one, [and] say, "Yes I did that" (RTran-752). He was hoping to build on that success and develop what he described as a sophisticated rubric for teachers.

In the next section, artifacts collected from Robert and his comments in the transcript of interview are examined for evidence of online instructional material associated with three main learning theories.

4.8.2 Theoretical Framework

Robert's responses were read for examples of characteristics of observable features expected to be evidenced in online learning environments or instructional material based on one of three major learning theories identified by Ally (2004). The results are presented under the headings of these learning theories: Behaviourist; Cognitive and Constructivist.

4.8.2.1 Behaviourist

Behaviourist theory discussed in Review of Literature, Chapter 2 is identified by Ally (2004) as producing "observable behaviour that indicates whether or not the learner has learned something" (p. 7). The examples of online instructional materials and learning environments described by Robert are listed under categories that Ally associated with Behaviourist theory and are presented in Table 4.36 below.

Table 4.36 Robert: Features of Behaviourist Theory

Features of Behaviourist Theory Ally (2004) expected in online instructional material	Online learning activity described by Robert
“Learners are informed of learning expectations so they can assess their own performance” (p. 7).	Robert commenting on the presentation of assessment criteria posted on the intranet, “I’ve re-arranged it . . . to generate the marks for the kids. [These are] our areas of assessment, readings . . . and writing. For example, a . . . Common Assessment Task, on issues and I’ve given the kids some feedback . . . this is a new thing; we’re integrating VELs into it” (RTran-697).
“Testing is integrated into learning experience to ascertain achievement and provide feedback” (p. 7).	Robert commenting on achievement and feedback, “. . . [It] is basically a way of facilitating a discussion between the teacher and the student in terms of assessment . . .” (RTran-678).
“Material is sequenced usually from simple to complex, to promote learning” (p. 7).	Robert explaining the structure of the online Class Log or Clog, “There’s two ways this can be set up, either where the kids put in top level posts and it appears here for everyone to see or there’s also a discussion board type thing . . . I can also give them extension activities . . .” (Rran-773).
“Feedback allows learners to monitor their own progress and determine an action” (p. 7).	Robert explaining online feedback, “We’ve got a journal where this is one-to-one. The kid writes something, I can read it, no one else can read it. The principle is that we have a tête-à-tête and no one else can go in it” (RTran-770).

The college’s intranet has an information structure that exhibits some of the features Ally expected in an online learning environment consistent with Behaviourist learning theory. It allows the school community to access curriculum documents that include course outlines, learning activities, and assessment rubrics, and supports interactive processes for both formal and informal feedback. The online learning material created by teachers was also accessible but parked in a less rigid structure which Robert described of as un-scaffolded. He explained that the administration’s policy was to leave the development of support and enrichment material largely “in the hands of the teachers” (RTran-1078). He recalled that the thinking was, the teachers felt “scaffolded to death [and that dropping] support material from on high” (RTran-1079) would not work.

In the Review of Literature, Chapter 2, Burton, Moore and Magliaro (2004) expanded Behaviourist theory into the four sub-categories of respondent learning, operant conditioning, observational learning and methodological behaviourism. When the online learning activities described by Robert were examined for features associated these sub-categories, features associated with the sub-category Observational learning were evident.

4.8.2.1.3 Observational Learning

Observational learning is characterised by Burton, Moore and Magliaro (2004) as *vicarious* learning. It derives from Social Learning Theory where learners observe “other people’s

behaviour and its consequences for them” (p. 12). Examples that illustrate Observational learning from the data collected from Robert are presented in Table 4.37 below.

Table 4.37 Robert: Components of Observational Learning

Features of Observational Learning Burton, Moore and Magliaro (2004) expected in instructional material	Features of Observational learning in the activities described by Robert
<u>Attention</u> observers sensory capacity (perceptual set) “Learners should be told why they should take a lesson so that they can attend to the information throughout the lesson” (p. 11).	“My year 12 class, they were all on Facebook. I’m not into Facebook; I know if I get into it then it’s going to be a real trap” (RTran-810).
<u>Retention</u> response patterns and how they are represented in memory in symbolic form	Robert observed a very high motivation for students to read: “Kids nowadays are in a screen culture life, where they spend most of their time looking at text on a screen it would seem” (RTran-807).
<u>Motor reproduction</u> organisation of responses on the basis of	Robert commenting on online feedback, “We do student evaluations, kids evaluate themselves . . . give themselves goals, and then they come back intermittently and say ‘Well I’ve done this and now I’m going to advance here’ ” (RTran-1157).
<u>Motivation</u> evaluative judgments that learners make about what they have learned and how it will affect their performance.	Robert explaining the college’s online reporting and feedback process, “That’s in keeping with that new student report card idea that the kid would be actively thinking about their learning and reflecting upon it” (RTran-1160).

In summary, the college organised the online curriculum in a hierarchy of structures that evidence, to varying degrees, all the features Ally (2004) expected to find in an online learning environment based on Behaviourist learning theory. Robert described these structures variously as a framework, a matrix and a rubric. When the structures were examined in detail it became clear that ‘framework’ described the overall structure, ‘matrix’ described a map with descriptive coordinates to help users find what they wanted and ‘rubric’ was a table of assessment requirements and marking descriptors for each learning outcome. The structure also included a process for interactive communication in general, and online feedback in particular, between teachers and students, that illustrate features Burton et al expected to be found in a learning environment based on the sub-category of Behaviourist learning theory called Observational Learning.

In the next section, artifacts collected from Robert and his comments in the transcript of interview are examined for evidence of online instructional material associated with Cognitive Learning Theory (CPLT).

4.8.2.2 Cognitive

Cognitive Psychology Learning Theory (CPLT) discussed in Chapter 2 Review of Literature is identified by Ally (2004) as internal learning processes involving the use of memory, motivation, thinking and reflection. Examples of online instructional material available in the online learning environment created by Robert which illustrate those features Ally identified, are presented in Table 4.38 below.

Table 4.38 Robert: Features of CPLT Observed in Online Learning Material

Features Ally (2004) expected in online learning material based on the CPLT	Features observed in instructional material described/demonstrated by Robert
Information carefully coloured, placed and paced to assists them perceive and transfer it to working memory.	The information maps for various year levels were black text on coloured background, the colour of the background signifying the year level. (Obs-R01)
Information . . . grouped into generalized categories using information maps.	Robert describing experimentation with information maps, “The other day, I was trying to do this relation between all these, about a dozen tables in a database And when you’re trying to make the relationships between a dozen different things, it gets to a point where you think, “No I’ll just see what happens now” (RTran-882).
Help learners construct a link between information in long term memory and new information	Robert describing Year 12 students using PowerPoint and interactive whiteboards for oral presentations, “To bring in images . . . to talk to . . . we had kids who did that incredibly engagingly, they would have an image and they would talk about it” (RTran-931).
Require learners to apply, analyse, synthesize and evaluate information.	“As part of the learning enquiry, they do a presentation of understanding. They would have had elements that they would present to the rest of the group” (RTran-926).
Materials . . . to suit various learning styles.	“I could pull this [video] up in my classroom and I can say, “Alright okay, so what we’ll do is we’ll pause it . . . Now we have a look at the magnetic field or the reduced currents, now let’s review it . . . you can see lots of changes, it does this, and the kids make theories about what’s going to happen, when it changes direction and so on and so forth” (RTran-185).
Support materials . . . appropriate to the learner’s preferred style.	Robert, explaining how the class log (Clog) allows students to interact with the online learning material in their time “After using this model with my Year 10 for a while, we talked through it in class; we explained things so if they knew the tasks that we were doing. They’d say, ‘Now this is going to be on Clog isn’t it?’ So they could go home and think about it in the privacy of their own bedroom.”(RTran-790).
Learning material . . . constructed to motivate learners.	Robert, explaining the development of an interactive learning activity for Romeo and Juliet, “I can put all sorts of multimedia materials in it . . . and they can interact with that, . . . this is very good to give the kid who’s so far out there that it’s impossible to keep up with them, give them stuff to pursue. [or] a bit slow at getting ideas, they can go in and read it” (RTran-786)

In summary the instructional material and learning environment evident on the college intranet created by Robert do exhibit features Ally (2004) associated with CPLT, in particular, the careful placement of colour in the online curriculum matrix to assist memory, the

grouping of information into generalized categories and the provision of audio and visual materials within the online learning activities to suit various learning styles.

In the next section, artifacts collected from Robert and his comments in the transcript of interview are examined for evidence of online instructional material associated with Constructivist Learning Theory (CLT).

4.8.2.3 Constructivist

Constructivist Learning Theory is discussed in Chapter 2 Review of Literature. From Ally (2004), this theory contends that “learners learn best when they can contextualize what they learn for immediate application and when they learn to acquire personal meaning” (p. 7). Table 4.39 below sets out examples the data collected from Robert which illustrate features Ally expected to be found in an online Constructivist learning environment.

Table 4.39 Robert: Features of Constructivist Observed in Online Learning Material

Features Ally (2004) expected in a learning Environment based on Constructivist Learning Theory	Features found in Robert’s descriptions of the online Learning environment he created
Strategies to make learning an active process.	Robert commenting on an online learning activity, “These kids are looking at which mode of transport’s most suited for students . . . [students send] an email to people to ask survey questions So this is an informal type of communication that the kids bring in from their MSN world and their continual texting of each other. . . . So there’s even social interaction” (RTran-907).
Opportunities for learners to construct their own knowledge.	Robert explaining the open ended nature of online learning activities “I can develop things, throw them at my kids and they say, ‘No that didn’t work . . . Why don’t you do this instead’ And off they all go to all these places. So we’re setting up all this stuff and helping them out, the kids are also building their own [networks]” (RTran-744).
An environment that encourages collaborative learning is promoted.	Robert explained “The idea of group wisdom [encouraged him to] build this online learning environment . . . where if people are collaborating then you’ll [gain] more than just the sum . . .” (RTran-505).

In summary, Robert’s vision for the online learning environment at the college exhibits the three features Ally (2004) associated with Constructivist Learning theory. First, the use of the latest communication technologies to make learning an active process. Secondly, activities that include online surveys and opportunities for students to build their own understanding of issues that affect society. Thirdly, investigation of these issues by groups of students who use the Internet to manage the allocation of tasks, “[keep] group logs . . . [co-coordinate] the email surveys [and present their findings] to their group” (RTran-919).

In the next section, artifacts collected from Robert, observations of the college's intranet, and his comments in the transcript of interview are examined for influences of the Internet.

4.8.3 Education and the Internet

For Robert the Internet provided an environment where students feel that “they can examine anything” (RTran-829). At Year 9 level, for example, he had set up an online program called Word Press on the college's intranet, to support enquiry-based learning activities for Year 9 students. For three weeks at a time, groups of 75 students are “given pretty much free range to . . . bring up whatever they want to” (RTran-899). At the end of the three week period each Year 9 group has what he called “a research Clog [Class Log]” (RTran-902), as a record of their research. He recalled one student commenting “It felt like at last I was being released from a cage” (RTran-831) .

With respect to the using the Internet for his VCE class, Robert was resigned to the fact that “there is a sort of sense that log learning [collaborative class logs] ends at Year 10, and then the kids are focusing on . . . the exam . . . [so] they can get the best possible marks” (RTran-837). For his VCE class, he was experimenting with online learning activities that modelled the knowledge building processes of WIKIpedia. He believed in the concept of group wisdom and thought that the WIKI process of spontaneous “building . . . rather than stopping and documenting everything” (RTran-1028) was worth trialling. At the same time, he had to ensure the information resulting from the WIKI editing process was accurate and that he was, in the role of moderator, “able to protect it because . . . normally in a WIKI everyone can edit it willy-nilly” (RTran-1030).

Robert hoped that eventually, the collaborative processes envisaged by the early Internet developers would prevail and enhance online learning, recalling:

My understanding is Tim Berners-Lee when he invented the Internet, it was meant to be like WIKIpedia. There was meant to be a button on every page where you [could] fix it up when people made mistakes. But then, of course, commerce and everything took it over and we lost that (RTran-980).

His question, “Do we just get out of the kids way?”(RTran-744), asked in a moment of reflection, suggests that he believes young learners, and their attachment to social media, will determine the future of the online learning environment.

Chapter 5 Cross-Case Report

5.0 Introduction

This chapter sets out the analysis of findings from the eight individual case studies to provide what Stake (2006) calls “an understanding of the aggregate” (p.39). The data collected from the eight experienced VCE information technology teachers, and presented in the individual case reports (Chapter 4), are analysed across the cases, following a coding process established by Stake in *Multiple Case Study Analysis*. The findings derive from the data collected, which comprise transcripts of interviews, examples of online instructional material and observations of online oncampus learning environments made by the researcher.

5.1 Cross-Case Findings

Whereas each case was examined in Case Reports, Chapter 4 with a view to understanding online oncampus learning in the participant’s individual situation, the cross-case analysis aims to examine what is common across the cases and identify what is unique to each particular case. The analysis followed processes set out in Stake (2006) which included referring back to data from individual cases during the cross-case analysis in the belief that “some of the important findings from those Cases will be context-bound” (p. 41). These processes are discussed more fully in the Methodology, Chapter 2. The findings are presented in the following three major sections: Emergent Themes 5.1.1; Theoretical Framework 5.1.2 and Education and the Internet 5.1.3.

5.1.1 Emergent Themes

This section presents findings from the cross-case analysis of themes which emerged from individual cases, under the headings of: the VCE; online instructional material and an online oncampus learning environment.

5.1.1.1 Victorian Certificate of Education (VCE)

This study examines online learning material and the online oncampus learning environment created for students studying the VCE (Victoria, Australia). When the data across all cases were examined, direct references to the VCE were infrequent. However the online learning activities in the data were all found to be situated within course outlines based on the key knowledge and key skills set out in the *Information Technology VCE Study Design* VCAA (2006a). When these findings were considered in association with the conclusion in Ally’s

(2004) research, they suggest that the *Information Technology VCE Study Design* conforms to the Behaviourist notion that “overt behaviours . . . can be observed and measured as indicators of learning” (p. 8). In their classroom teaching, participants described strategies to keep their students focused on the VCE IT learning outcomes, particularly when the students were using the Internet and items of interest sparked class discussions in directions that had no direct relevance to a VCE-sanctioned key knowledge point. This finding suggests the teaching strategies employed by participants were strongly influenced by direct online access to the content of the entire VCE IT curriculum. Students in the participants’ classes had direct access, via the Internet, to the assessment descriptors mandated for the VCE IT curriculum and to a range of online practice assessment tasks, allowing interviewees to immediately direct students to appropriate material. Students could use these resources, either individually or in groups, to gauge their achievements against stated VCE IT standards. This is consistent with the Ally (2004) contention that in a Behaviourist environment “online testing or other forms of testing . . . should be integrated into the learning sequence to check the learner’s achievement level and provide appropriate feedback” (p. 8). The online quizzes integrated into the learning activities replicated both short answer and multiple choice questions from previous VCE IT end-of-year examination papers. Similarly, the case study scenarios and associated reports required within cumulative assessment tasks reflected in style and format, the questions requiring extended responses found in past examination papers. This also reflects a major feature Ally (2004) expected in an online environment based on Behaviourist Learning Theory, that “learners are informed of learning expectations” (p. 7).

Across all cases, the online learning environments described by the interviewees reflected all four design principles Ally (2004) associated with Behaviourist Learning Theory. First, the online learning activities and the oncampus classroom interactions were dominated by the key knowledge and skills set down in the VCE IT curriculum. Second, the schools’ intranets and overhead projectors were used to convey the content and structure of that curriculum and combined to reinforce the two main goals of the course: achieving the learning outcomes to a designated standard and gaining a good ENTER score (Equivalent National Tertiary Entrance Rank). The ENTER score has changed to ATAR (Australian Tertiary Admissions Rank) and at the state level VICTER (Victorian Tertiary Entrance Requirement). Third, learners are informed of what is expected, and tested to measure achievement. Fourth, learners are provided with instructional material sequenced from simple to complex and provided with detailed feedback that allows them to check their own progress.

5.1.1.2 Online instructional material

This research is also a study of the online learning activities created or selected by the participants to instruct in their VCE classes. When the data across all cases were examined for descriptions, artifacts and observations of learning material designed and used in the online environments, five categories of online material were identified. These were online material:

- i. created by the participant
- ii. used by the participant
- iii. chosen to motivate students
- iv. designed for collaborative learning
- v. chosen to support different learning styles.

The online materials in these five categories in the first instance are strongly influenced by design principles Ally (2004) associated with Cognitive Learning Theory. These include: colour, placement and pacing to help transfer information into memory; activities which promote thinking and reflection; and features that motivate learners.

They also evidence elements associated with three theories discussed briefly in the Review of Literature, Chapter 2, namely: Keller and Suzuki's (1988) ARCS model for motivating learners; Gardener's (1983, 1999) theory of Multiple Intelligences; and Young's (2006) categories for web-based learners derived from Activity Theory. Briefly, Keller and Suzuki contend that students are motivated to learn where the instructional material is based on their model ARCS (attention, relevance, confidence and success) which refers to four features which can be included in the design of learning activities. Gardner (1983) contends that there are "differences among minds" and learning activities should be designed from a "multiple intelligences perspective" (p. 187). Young (2006) generated categories to describe young web-based learners using Activity Theory. She contends that learning is a socially organised practical activity and a tool-mediated activity that unites the mind with real world of activities and events.

Cognitive Learning Theory from Ally's (2004) model, together with the theories of Keller and Suzuki (1988), Gardner (1983) and Young (2006), were then used to frame the discussion of the following five categories of online material referred to above.

i. Online material-created by participants

All participants created/selected interactive learning activities for their students. Participants worked online with other teachers and their students to collaboratively collate subject specific knowledge data bases or WIKIs for specified VCE class projects. Those participants who

designed and/or created complete sets of both individualised and team-based online learning activities did so to meet the learning outcomes for the VCE Information Technology. This concurs with Keller and Suzuki (1988) where motivation is stimulated by “connecting the content of instruction to the learners’ future job or academic requirements” (p. 231). This is further evidenced in the online templates participants created to help VCE IT students complete assessment reports in a standard format. The templates were developed from the assessment descriptors in the *VCE Assessment Handbook Information Technology 2007-2010* (2006b) and shared online via the teachers’ email list. In the researcher’s experience, a standardized template gives students a greater opportunity to complete an assessment report to a high standard. This concurs with findings by Keller and Suzuki where a belief that success is possible, serves to motivate learners because it increases their confidence.

ii. Online material-used by participants

The online learning material available on the Internet was used by the participants in most instances to provide step-by-step instructions for computer applications such as Flash, ActionScript, Microsoft Excel, Microsoft Access and Visual Basic. The participants also encouraged students to vary formal learning activities, with play and problem-solving games. Keller and Suzuki (1988) believe providing variety in the design of online instructional material helps to hold a learner’s interest. Varying the means by which learners’ attention is captured and then retained was also evident in the audio and video reports students were encouraged to create for revision, as part of their formal assessment, and for self assessment. Instructional material designed to gain and maintain the learner’s attention (A) is one of the four ARCS components which Keller and Suzuki contend is necessary to motivate learners.

iii. Online material -chosen to motivate students

Online learning material that would motivate students was sought by all participants. The interview responses indicated that they were always seeking learning activities that would generate enthusiasm among students. They were pleased to recount instances where students created video presentations to explain what they had learned or used social media and email to collaborate on tasks and complete work at home. Prompt feedback was also viewed by all participants as a motivating factor for successful student learning. All participants described using online communication to provide timely and individualised feedback to students and had observed students motivated to improve their study score by constructive feedback. The belief that each small success would encourage students to keep learning is consistent with the ‘confidence’ component of Keller and Suzuki’s (1988) ARCS model. Students are motivated to learn where timely feedback increases their expectations for success. Further, with respect to Year 12 VCE, this data confirms the Keller and Suzuki belief that where students have

direct access to all of the learning requirements and assessment criteria, and to a wide range of appropriate online resources, they [students] take responsibility for their own learning because they “attribute their success to their own abilities” (p. 231).

iv. Online material-designed for collaborative learning

Online instructional materials designed to motivate students were also evidenced in the collaborative learning activities that promoted enquiry based learning using role plays in simulated/virtual environments. These were seen by participants as helping students understand the key knowledge points, because they were explored in ‘context’. This is supported by the Hamid, Waycott, Kurnia and Chang (2010) contention that “awareness emerges from an individual participating in a social structure where activity incorporating the use of tools to produce objectives leads to socially valued outcomes” (p. 1418). Their contention derives from Activity Theory, which Hamid et al believe can be used to describe learning environments with the features they describe.

Participants’ observations and the online material they developed to motivate students, also concur with a conclusion from Young’s (2006) study, that “. . . we must try to understand how this technique [students’ easy use of the Internet] . . . has changed learning and what . . . educators need to do to facilitate growth and maximise experiences” (p. 17). This conclusion is applicable in the environment under investigation where learning activities are supported by school-mediated access to the Internet, interactive whiteboards and wireless laptops/tablets because it offers the possibility for linking ‘socially valued outcomes’ to VCE learning outcomes. The schools’ intranets and overhead projectors mean that class activities can be easily shared as group learning experiences, or reviewed out of class time by individuals or by groups.

v. Online material-chosen to support different learning styles

Online learning material to support different learning styles was sought by all participants. They worked individually and within the VCE IT teachers’ email discussion group to develop innovative online learning material. Interviewees shared and trialled interactive activities that included: embedded video and audio instructions; and links to text reading programs that students could select. Participants encouraged individual learners to find and evaluate online material and try alternatives tutorials until he/she found a style or mode that he/she preferred. Participants were aware of Gardner’s (1983) theory of Multiple Intelligences and they were facilitating online learning environments accordingly. In the lessons described by the interviewees, their students had access to online instructional material presented using a variety of delivery modes and were given opportunities to choose from material designed for

a wider range of learning styles than is currently addressed by the dominant ‘linguistic’ (word smart) or ‘logical-mathematical’ (number smart) approaches.

Material designed in accord with Gardner’s (1983) Multiple Intelligences is also evident in the online learning activities and teacher support material created by participants in this study and published by the Victorian Curriculum and Assessment Authority VCAA (www.vcaa.vic.gov.au), and the Victorian Information Technology Teachers’ Association VITTA (www.VITTA.com.au).

Participants also described what Raglan, Smith and Curda (2008) called experience-centred learning. This is evident in their accounts of individual students pursuing areas of interest as extensions to whole-class activities. Common elements in these extension activities were: the use of the Internet as a resource; ongoing teacher-student interaction until a goal determined by the student was achieved; and reports posted online for other class members to share. These data provide further evidence of online instructional material that caters not only for the ‘linguistic’ and ‘logical-mathematical’ intelligences but also ‘spatial’ and ‘interpersonal’ intelligences. The data are rich in examples of strategies that indicate an awareness of the need to address different learning styles in the face-to-face oncampus interactions. It was clear that access to the Internet has added to the participants’ ability to find appropriate instructional material as the need arises. YouTube was frequently mentioned as an effective multimodal resource, but not available on campus. Interviewees only included YouTube in the curriculum as part of home activities, because Victorian secondary school colleges had policies that prevented students accessing the site oncampus.

5.1.1.3 Online oncampus learning environment

The online oncampus communication technology is the third emergent theme examined in the cross-case analysis. Participants were actively involved in the selection of software and hardware to meet school-wide policies associated with information and communication technologies. In some instances this extended to taking responsibility for the purchase and maintenance of the hardware and software. In all cases the participants used the online oncampus environment to teach VCE IT. When the data across all cases were examined for descriptions, artifacts and observations of the oncampus online environment, the following three categories were identified:

- i. an intranet that supports collaborative learning
- ii. participants providing PD for other staff
- iii. participants taking responsibility for the school’s intranet.

i. *The first category: An intranet that supports collaborative learning*

All participants described school intranets that enabled collaboration in the form of email, chat rooms, WIKIs and forums, along with moderated access to the Internet. They described their students using email, chat sites and/or forums for real-time communication. Using a variety of communication technologies, interviewees organised online collaborative environments for their own classes and provided the expertise for other VCE IT teachers to do the same. Participants provided online help for teachers in other schools who wanted to build whole-school networked environments. Unmediated access to knowledge on the Internet was seen by participants as an important aspect of managing face-to-face and online learning interactions and they offered advice to other teachers on how to manage whole-class collaboration and direct access to knowledge when using interactive whiteboards. Late in the research period, references to social media as a means of oncampus collaborative learning occurred more frequently in the data. This concurs with an observation in Ally's (2009) later work *Mobile Technologies*, where he states, "As the citizens of the world use mobile technology to complete everyday tasks and to socialise with friends and colleagues, they will demand access to learning materials using mobile technology" (p. 1).

When the study commenced, oncampus electronic communication was largely via class sets of wireless laptops accessing school intranets and linked to overhead projectors for whole-class discussions and activities. Email was used for *student-student* sharing of work files and in *student-teacher* interactions for submitting work and receiving feedback. As the study progressed, references were more frequent to students using personal communication technology such as social media, smart phones and tablets alongside school-based email, to search for information, complete learning activities and submit work. These observations, and the ready use of the term '*digital native*' by participants to describe students who have grown up using the Internet, suggest that pedagogy for an online environment is evolving. McLuhan (1967) commenting on a similar situation when educators were debating the effect of the new medium television, advised that it was first necessary to "grasp its relations to other media, both old and new" (p. 216), and reminded his readers that "persons grouped around a fire or candle for warmth or light, are less able to pursue independent thoughts, or even tasks, than those supplied with electric light" (p. 382). If McLuhan's observations are applied to the new online oncampus environments, where intranets are linked to interactive whiteboards, smart phones and tablets are used to facilitate collaborative learning, and students sometimes have unmediated access to the Internet, there is the possibility of greater autonomy for learners.

ii. *Second category: Providing PD for staff*

All participants described situations where they were training staff to use online facilities. They were expected, in the first instance, to help teachers upload learning activities to the school's intranet, and in the long term, develop procedures all staff could follow to deliver and manage the online oncampus curriculum. Anecdotes in the data recount attempts to help individual teachers upload instructional material and/or create forums, chat rooms and WIKIs for collaborative learning activities. Participants had responsibilities to create, deliver and evaluate formal PD programs for their own schools and for teachers in schools across the State of Victoria (Australia). A common feature of the PD delivered by participants was instruction on how to incorporate digital learning objects into existing lessons. The immediate objective was to encourage teachers to access the website:

(www.education.vic.gov.au/student/learning/teaching_resources), and use the online PD program entitled *Using Digital Learning Objects*. In the long term the aim was to have more digital learning material on schools' intranets, and as a consequence, provide more opportunity for students to copy learning activities directly onto their own personal mobile devices.

When all the participants' observations of schools' PD programs were examined, the sentiment most frequently expressed was that it was difficult to generate enthusiasm amongst teachers with top-down, one-size-fits-all PD sessions. Some participants, for example, described organizing whole-school sessions for staff to learn specific software applications, and lamented that the skills gained were not evident in changed teaching practices. They had tried various approaches to overcome the PD problem. The most wide reaching and successful was an email list, initially for VCE IT teachers and more recently extended to lists for other VCE subject areas. One participant had taken time release to work in a commercial enterprise to create and market online learning activities. All had facilitated individual and group teacher-teacher and teacher-student informal PD sessions, in their own schools and on a state-wide basis.

iii. *Third category: Responsibility for the school's intranet*

All of the participants were expected to take some sort of responsibility for their school's intranet. Each spoke of working with his/her schools' technicians to ensure the required software was available for classroom teaching and easily accessible by staff and students. Each believed that fostering reliable technical support and developing a formal infrastructure around interactive network technology was an important aspect of their role as a VCE IT teacher. Some described their school's experiments with successive generations of networked file sharing software, with most finally opting for MOODLE to manage the delivery of an

online curriculum. Two outlined their respective schools' commitment to online environments where all classrooms were equipped with interactive whiteboards, and where students, parents and teachers could access all VCE instructional material, learning outcomes, academic regulations and class timetables. Both of these interviewees are in exemplar schools specially funded by the Victorian Government to develop and showcase innovative environments. A particular concern for these two participants charged with showcasing 'the latest' in learning technologies was the need to keep their schools' hardware and software sufficiently up-to-date, in order to communicate seamlessly with students' smart phones and tablets. This concern is reflected in Ally's (2009) introductory statement to a collection of studies of mobile learning that "education and training have no other choice but to deliver learning materials on mobile devices" (p.1).

In summary, the themes which arose show that participants and their students had unmediated access to the VCE learning outcomes, academic regulations, and instructional material via the curriculum authority's website, www.vcaa.vic.gov.au. All participants used online instructional material, be it virtual learning environments accessed via the readily available mobile technologies, or online feedback integrated into the learning process. Three participants created online instructional material for their own Year 12 students and were also involved in the commercial electronic distribution of that material to others. All participants used software designed to manage the delivery of online learning materials via their schools' intranets. Seven of the eight used the Government sponsored MOODLE and one used Blackboard, a product used mainly by tertiary institutions. All participants were enthusiastically involved in their individual school's development of infrastructure to support online oncampus learning and the delivery of associated PD for other teachers.

5.1.2 Theoretical Framework

This section presents findings from the cross-case analysis that illustrate features Ally (2004) associated with the three learning theories: Behaviourist, Cognitive and Constructivist. These make up the theoretical construct used to examine the data collected in this study and were discussed in the Methodology, Chapter 3. The findings across the cases are presented in the summary Tables 5.1, 5.2 and 5.3 (Appendix I). They are discussed in this section as they relate to the VCE, online instructional material and an online oncampus learning environment.

5.1.2.1 Behaviourist

Behaviourist Learning Theory, the first theoretical construct used for the analysis of data collected from the eight participants, is identified by Ally (2004) as producing “observable behaviour that indicates whether or not the learner has learned something” (p. 7). The cross-case analysis of features Ally associates with Behaviourist Learning Theory are presented in Table 5.1 below. They are discussed in the following two sections first as they influence the VCE IT curriculum documents, the Online Learning Environment, and Online Learning Materials and secondly as they feature in the sub-categories of Behaviourist Learning Theory identified by Burton, Moore and Magliaro (2004).

Table 5.1 Cross-case Summary: Features of Behaviorist Theory

Features of Behaviorist Theory Ally (2004) expected in online instructional material.	Occurrence of Illustrative Online Learning Activities Across the Cases							
	Catherine	Alan	Margot	Bill	Gary	Daniel	Louise	Robert
“Learners are informed of learning expectations so they can assess their own performance” (p. 7).	2	2	2	2	2	2	2	2
“Testing is integrated into learning experience to ascertain achievement and provide feedback” (p. 7).	1	1	1	3	1	1	1	1
“Material is sequenced usually from simple to complex, to promote learning” (p. 7).	1	3	1	1	1	1	1	1
“Feedback allows learners to monitor their own progress and determine an action” (p. 7).	1	1	1	1	1	1	1	3

Legend: Frequency of Observed Characteristic in Data

Not Observed	Infrequently Observed	Observed	Frequently Observed
	1	2	3

The *Information Technology VCE Study Design* VCAA (2006a) sets down the learning outcomes and key knowledge points, and the *VCE Assessment Handbook Information Technology* VCAA (2006b), provides conditions for both cumulative and summative testing. Both documents exhibit all the features Ally (2004) expected in an online learning environment based on Behaviourist Theory. In all cases VCE students have direct unmediated online access to the detailed rubrics of marking descriptors via the schools’ intranets or the Internet. By these means, the students studying VCE Information Technology are informed of learning expectations and associated testing which is integrated into the learning experience.

The online instructional material available on the curriculum authority's website is sequenced from simple to complex, again conforming to design principles Ally (2004) expected. There are also detailed annual online assessment reports on students' responses to both cumulative assessment tasks and the end of year examinations. The online learning environments described in the data include online reporting processes that provided students with individual feedback on their performance. At the time of the interviews this was most often in the form of annotated Word documents attached to emails.

The information on the schools' networks included the administrative regulations and formal course requirements of the VCE. Students have direct unmediated access to the regulations which govern how VCE assessment tasks are to be scored. This is important information because it pertains to scores that are used to determine access to limited university places. Students also have direct access to administrative regulations governing the VCE IT study. These are features Ally (2004) expected to find in an online learning environment designed on principles of Behaviourist learning and included:

guidelines on plagiarism, privacy, academic appeal procedures, library facilities and access to counselling and advisory service . . . [together with formal course requirements] . . . course syllabus . . . instructor contact information, . . . course overview, course schedule . . . list of required texts and materials . . . clearly defined academic and computer skills, prerequisites, clear communication about expectations . . . assignments and deadlines, faculty contact information (p. 178).

The school-wide online learning environments were built round software specifically designed to deliver curriculum material and manage the learning activities. At the classroom interfaces, overhead projectors and wireless laptops used as class sets, provided access to this information via schools' intranets. Fully interactive whiteboards and programs identified in Coghill's (2010) research, *A Model of Pedagogical Change for the Evaluation of Interactive Whiteboard Practice* were being developed by two of the participants. In line with the conclusions in Coghill, those two participants hoped to develop and model classroom practices that would make day-to-day classroom management easier. Responses in the participants' data suggest they would fully concur with Coghill and believe the interactive whiteboards allow the teacher to get the class working quickly. Teachers can draw on the students' work or demonstrate a problem and teach "concepts and skills . . . recap and move between pages so that the class has access to earlier work" (p. 169).

The online learning materials in the data conform to general principles Ally (2004) associated with Behaviourist Theory. The online curriculum documents of the VCE on the curriculum

authority's website www.vcaa.vic.edu.au, inform learners of what is expected and how they are to be assessed. The individual instructional activities, whether tutorials sourced from the Internet, or activities designed by the participants, conform to the general principles of Behaviourist Theory in that they also inform students of the learning objectives so that they can assess their own performance. The online instructional materials examined in this study routinely sequenced material from simple to complex and integrated testing into the learning experiences so that learners could make judgments about how to proceed on the basis of immediate feedback.

In most instances, participants successfully adapted general online material into whole-class activities to address key VCE learning outcomes. The practice is encouraged by the curriculum authority which created an online resource DigiLearn <http://www.education.vic.gov.au/studentlearning/teachingresources/ict/learnobj.htm> (Appendix G), to promote the use of digital learning objects amongst teachers. It also has qualified support in The Learning Objects Literature where Wiley (2008) states that digital learning objects can be downloaded and localized to fit the immediate needs of a learner during a particular lesson. However, Wiley goes on to warn that those aiming “to automate a just-in-time assembly of learning objects into personalized education learning experiences rely on learning objects adhering to specific structural and content standards” (p. 352). The participants in this study are specialist computer teachers, and had the technical skills to integrate digital learning objects into lessons; whether teachers in general have these skills is not known. The data suggest that adhering to ‘structural and content standards’ is a matter of professional judgment. In the VCE IT environment examined, lessons conform to Behaviourist Learning Theory and have the learning objectives stated up front, therefore it is theoretically likely that lessons can be matched with appropriately classified digital learning objects.

In the next section, Respondent Learning, Operant Conditioning, Observational Learning and Methodological Behaviourism are discussed. These are the four sub-categories of Behaviourist learning identified by Burton, Moore and Magliaro (2004). The occurrence across cases is presented in Tables 5.4 to 5.7 (Appendix I).

5.1.2.1.1 Respondent Learning

Respondent learning is the first sub-category of Behaviourist Learning discussed. Burton, Moore and Magliaro (2004), state that Respondent Learning derives from the theory of Conditioned Response which is associated with the techniques of Ivan Pavlov. Its general premise is that learners can be gradually trained to respond to what is initially a neutral

stimulus, such as a whistle. In this study, changes to text-colour, noises and screen alerts were observed as both positive and negative stimuli in the Microsoft applications used to teach programming. When learners create error-free code using Microsoft FrontPage, the text colour is blue or brown or green. If they make an error the text remains black. Negative stimuli in the form of attention-grabbing noises are found in the tutorials for Flashclassroom and ActionScript. These are programs used by VCE students to create online games and computer graphic images. Microsoft uses noise and animated text-image combinations in all of its products as a standard negative alert to warn users that an action may cause loss of data. Negative stimuli of these types are common features of general programming and a feature of instructional material designed by participants. Positive stimuli were evidenced in the form of scores, reports and prizes. These are common in online tutorials and games.

5.1.2.1.2 Operant Conditioning

The second sub-category of Behaviourist Learning Theory is Operant Conditioning, where fully automated tutorials have automated sequences of cues, operands and consequences in line with stated educational goals. The Bryce and Flashclassroom automated online tutorials were used by participants when they recognised a student needed individualized instruction in particular skills. These tutorials typically state a learning objective at the beginning and set out a sequence of activities to achieve that objective. Burton, Moore and Magliaro (2004) contend that this type of automated learning experience provides the “practice and contiguity . . . [and] trial and error experiences” (p. 12) to foster complex learning and problem solving. Tutorials of this type also cater for the transfer of learned behaviours from an initial setting to a new setting.

Complex learning, problem solving and transfer, which Burton et al (2004) associate with Behaviourist Learning Theory, were evidenced in the online tutorials and learning activities described by the participants. Interactive tutorials are used to teach a variety of learning outcomes. These range from programming languages to virtual scenarios where ‘players’ canvas ethical issues associated with the introduction of data matching technology in simulated business environments. These interactive/online learning experiences exhibit sequences of linked learning tasks that involve problem solving and promote complex learning. The learning activities created or sourced by all participants, required students to test possible solutions in virtual scenarios and determine which were most likely to succeed when transferred to a new situation. These online tutorials conform to the Burton et al description of learning activities that require students to transfer learned skills and knowledge. Problem solving and knowledge transfer are mandated in the *Information Technology VCE Study Design* VCAA (2006a), which outlines four prescriptive and cumulative assessment tasks.

There are many examples of learning activities on the IT teachers' email list that act as trial assessments. Interviewees believe their students routinely learn the key knowledge set out in the *Information Technology VCE Study Design*, practice the key skills in a trial assessment and then transfer them, in accordance with Burton et al's description of transfer, "to a new task that has similar elements" (p. 12).

5.1.2.1.3 Observational Learning

The third sub-category of Behaviourist Learning Theory is Observational learning. It is based on the idea that new behaviour can be learned by observing the behaviour of others. The participants all recounted learning activities that evidenced the four processes Burton et al (2004) associated with Observational learning, namely: attention; retention; motor reproduction and motivation.

The participants described students interacting with commercially created tutorials such as Flashclassroom and working with other students, to create online tutorials. The learning processes interviewees described are consistent with the 'attention' component of Observational learning identified by the Burton et al (2004). They contend that learners pay particular 'attention' to the content and sequence of information with all of their senses because they are told at the outset what the lesson is about. Participants' explanations of their own interactions with students during the development of online learning tasks also illustrate their efforts to encourage deeper learning, via the 'retention' component of Observational Learning. Their accounts of learning activities and the associated conversations with students, conform to the Burton et al (2004) notion that 'retention' of what is learned via the senses is remembered in an organised symbolic form as a pattern in memory and that it results primarily from "imaginal and verbal codes for observed performances"(p. 12).

The other two components of Observational Learning identified by Burton et al (2004) as necessary for learning are 'feedback' and 'motor reproduction processes' (more commonly recognised as practice). The data suggest that the presence of computers in the environment enhances the ability to monitor the response of learners and provide feedback. The participant teachers can electronically monitor the online conversations between student groups because in many instances the students are working online and communicating with each other using school based intranets. The interviewees were able to follow the progress of collaborative projects where VCE students set up a WIKI as part of a project and follow threaded discussions between groups of students completing their homework. Participants 'watching' electronic interactions between students are therefore in a position to provide immediate feedback which allows for timely corrective adjustments to the learning processes. Students

can record the interactions and assess their own progress and select a course of action. There are forums and chat sites where students can participate or follow discussions that function as feedback and influence their learning. In both scenarios the Internet offers tutorials that provide instruction at the point of 'need-to-know'. The data shows that learning facilitated by immediate feedback and accompanied by appropriate practice (the Burton et al motor reproduction process) is enhanced in virtual environments because students can physically and electronically observe each other in their 'work' roles. The storage facility provided by electronic networks allows students to examine at their leisure, online documents created for a 'role-play' situation.

Motivating learners, or stimulating students' enthusiasm for learning, is a component of all learning theories used to examine data in this study. It is considered here within the Observational Learning component of Behaviourism, and is evident in many of the online learning activities described by participants. Burton et al (2004) identify external reinforcement, vicarious reinforcement, and self reinforcement as three elements of motivation. They describe them as "processes that promote the learning and performance of observed behaviour" (p. 12). These elements are evident in learning activities integrated into online tutorials and games found in the data. In general, external and self reinforcement are seen in features such as scores or prizes, which allow students to demonstrate competency to other students and/or themselves. In collaborative activities each student can feel a sense of achievement in the success of the group or other individuals in the group. Where the collaboration is online, close observation of another's performance is enhanced by chat rooms, WIKIs, forums and multi-user games. Arguably, the online collaborative learning experiences described by participants, motivate students with external, vicarious and self reinforcement.

The learning activities which illustrate observational learning varied from case-to-case, but they all contained what Burton et al (2004) characterize as "simpler and more complex material [that] can be used to accommodate learners at different knowledge levels" (p. 11). In addition, the information in the activities was chunked to prevent what Burton et al describe as "overload in working memory" (p. 12). The data indicates that participant teachers had strategies to promote higher-level learning, where students were asked to apply knowledge, analyse problems, synthesize and evaluate solutions. A similar strategy is evident when the learning objectives of the *Information Technology VCE Study Design* VCAA (2006a) are examined. In this document teachers are instructed to set problems which require application, analysis, synthesis and evaluation. The resource material provided in this document includes links to existing subject-based knowledge together with references to questions from previous

examinations. It is argued that by these means, the learning objective includes motivating learners to use the Internet to find information for themselves.

However, the data collected from one participant did not evidence features associated with Observational learning. These data are rich in descriptions of a school-wide online learning environment and interactive learning material, but poor in anecdotes of student learning. I believe that this particular participant's role as an ICT innovator within the school's leadership team kept his focus on the bigger picture and influenced his responses. His observations offer a strategic viewpoint to other VCE IT teachers and helped me to interpret examples of Observational Learning in the data collected from the other participants.

Two final theories associated with Observational learning are Social Learning Theory and Symbolic Modelling. Burton, Moore and Magliaro (2004) characterize Social learning as learners observing "other people's behaviour and [making judgements about] its consequences for them" (p. 12). Symbolic Modelling, they contend, results from watching live or filmed performances, or descriptions of performances. Social Learning Theory and Symbolic Modelling are beyond the framework set up to examine the data in this study. However, they are used to discuss possible future directions for research in Section 5.1.3, in relation to a theme which arose in the cross-case analysis, namely 'teachers as learners'.

5.1.2.1.4 Methodological Behaviourism

Methodological behaviourism is the fourth sub-category of Behaviourism, an element of the theoretical construct used to examine data collected in this study. It is characterised by Burton, Moore and Magliaro (2004) as closely associated with the early development of instructional technology. Data classified as examples of Methodological behaviourism are limited in this study to automated instruction, online question and answer (Q and A) tutorials and automated tutors. While individual references to these instructional forms are found in the data collected from all participants, examples from only two of the participants exhibit what Burton et al call one of "the distinctive aspects of the methodological approach" (p. 13), namely, that learners are required to respond correctly to appropriate stimuli under prescribed conditions. The occurrence of examples from the data collected from the two participants are presented in Table 5.7, (Appendix I).

The automated learning activities examined in the data utilized computer controlled sequences of text, audio and video materials. The data collected from the first of these two participants was sourced from the Internet. Students of this participant worked individually online in class for assigned lengths of time and then the class was called together to summarise the information. This participant did not automate his own instructional material,

but referred students to online training videos/tutorials where the sequence is controlled. He used Q and A quizzes with built-in assessment, and directed students to the automated tutorials that accompany software Help files. The second of these two participants created a complete online learning environment for each IT subject he taught. In this participant's classes each VCE IT student logged into the school's intranet to gain access to learning activities. He had created assessment procedures linked to quantitative feedback, to extension activities and to grading and reporting. The automated assessment procedures diagnosed areas of weakness in each student's performance, provided a recommendation for further study and the opportunity to retake the particular quiz. Both of these teachers used online Q and A tutorials automated to monitor and analyze learners' responses. Both made use of email and chat facilities to monitor learners' experiences and both used the Internet to provide appropriate help. The first participant monitored his students' progress in person as they worked online in class. He encouraged his students to come to him when they believed they needed help. He had extensive knowledge of online learning activities that included automated instruction, quizzes and automated tutorials. The second participant constantly adjusted an automated online system to analyse individual students' responses to quizzes, and direct them to an appropriate tutorial or to an extension activity.

In summary, the instructional material and learning environments described by all participants exhibit the general features Ally (2004) associates with Behaviourist Learning Theory together with more specific features designed to promote complex learning, problem solving, and the capacity to transfer learned skills and knowledge to new situations. Elements found in the design of these online learning activities equate with design elements Burton et al (2004) associate with Respondent learning, Operant conditioning and Observational learning, three of the four major sub-categories of Behaviourist Learning Theory. Methodological behaviourism, the fourth major sub-category, and from the perspective of the historical development of computerized instruction, most likely to feature in online learning material, was evident in only two cases.

The next section discusses the findings, across all cases, of features Ally (2004) expects to find in online instructional material based on Cognitive Learning Theory.

5.1.2.2 Cognitive

Cognitive Psychology Learning Theory (CPLT) discussed in the Review of Literature, Chapter 2 is identified by Ally (2004) as an internal learning process involving the use of memory, motivation, thinking and reflection. The cross-case analysis of identifiable features

that Ally expects in online learning material that utilises CPLT is presented in Table 5.2 below, and discussed in this section.

Table 5.2 Cross-case Summary: Features of CPLT Observed in Online Learning Material

Features Ally (2004) expected in online learning material based on the CPLT	Features of CPLT Observed Across Cases							
	Catherine	Alan	Margot	Bill	1Gary	Daniel	Louise	Robert
“Information carefully colored and placed to assists them perceive and transfer it to working memory” (p.16).	1	1	1	3	1	1	1	1
“Information . . . grouped into generalized categories using information maps” (p.16).	1	1	1	3	1	1	1	3
“Help learners construct a link between information in long term memory and new information” (p.16).	1	1	1	3	1	1	1	1
Require learners to apply, analyse, synthesize and evaluate information” (p.16).	1	1	1	1	1	3	1	1
“Materials . . . to suit various learning styles” (p.16).	1	1	1	1	1	1	3	1
“Support materials . . . appropriate to the learner’s preferred style” (p.16).	1	1	1	1	1	1	3	1
Learning material . . . constructed to motivate learners” (p.16).	1	1	1	1	1	1	1	1

Legend: Frequency of Observed Characteristic in Data

Not Observed	Infrequently Observed	Observed	Frequently Observed
	1	2	3

Memory, the first of the internal learning processes, is enhanced by the use of colour, placement, pacing and the use of information maps to help learners link new information to existing information. In the various interactive learning activities referred to by all eight participants, colour, placement and pacing are utilised to enhance the efficient transfer of knowledge from an initial sensory perception to long term memory. The Flashclassroom and Bryce tutorials, Kahootz online learning activities and a large number of other online tutorials use colour to identify groupings of like activities, and to differentiate between types of activities. The curriculum authority offers free access to the software package, Inspiration, to help teachers utilize colour and placement in the learning activities they create. Inspiration software provides a standard template of colour and placement that teachers can use to create the learning activities for schools’ websites. The design features teachers are encouraged to use fit the Walpole and Smolkin (2004) category of ‘considerate’ texts. These are texts

designed to make reading easy for the learner. Instructional materials in this category have “strong introductions; headings and sub-headings and tables outlining the texts’ structure” (p. 198). These features are also found in online teacher support material created for the VCE IT section of curriculum authority’s website (VCAA), which includes learning activities and assessment materials created for students. The design principles are consistent throughout the online materials on the website and exhibit what Walpole and Smolkin refer to as global coherence. The VCE online curriculum, from the general overview to the detailed list of key knowledge and skills, has straight forward navigation, which Walpole and Smolkin argue, offers students a chance to build and practise cognitive strategies before they are confronted with more complex information structures. The online instructional material, colour-coded information maps and text based documents of the VCAA website are formatted in the strict house-style of the curriculum authority (VCAA), which conforms to the design principles of CPLT.

Thinking and Reflection, the second of the internal learning processes Ally (2004) identifies, are required when students are presented with problems that require analysis, synthesis and evaluation of information. Comprehension is arguably central to this internal learning process, and is considered by Walpole and Smolkin (2004) within the Cognitive pedagogy. They describe comprehension as the active process of extracting meaning and integrating prior knowledge and text content. The online instructional materials, selected from the data, all had provision for extension activities that required students to complete tasks and solve information problems in a variety of contexts, and by these extra demands, encouraged students to think. When the processes promoted by these activities are examined in detail they match the processes Walpole and Smolkin associate with comprehension, namely: the reader initially linking words into phrases and then processing the text to maintain local coherence. Walpole and Smolkin contend, that this is the actual cognitive process which leads to overall understanding of the text, and this is consistent with the participants’ descriptions of how some students learn from online instructional materials.

The online activities in the data were also examined together with interviewees’ descriptions of the classroom interactions that accompanied those activities. The interactions were largely personal anecdotes and could be classified as the participant/teacher clarifying/exploring the instructions with the learner. These anecdotes reflect the Walpole and Smolkin (2004) finding that teachers need to “analyse and mediate between the specific demands of the text and the specific skills of the readers” (p. 199), in order to develop students’ skills in thinking and reflection. This practice is also described in a list of appropriate teacher practices Ally (2004) associates with CPLT.

Motivation is the third of the internal learning processes Ally's (2004) associates with online material based on CPLT. He argues that motivation is stimulated with online learning materials that cater for various learning styles. The data in the current study suggests that the participants would agree. They all refer to instructional material where an audio and/or video tutorial is included, or where students are required to create reports using an audio and/or video medium. The interviewees described successful online learning activities that utilize multimedia, chat rooms, WIKIs, forums and Blogs, for both local and global *student-student* interactions. The data strongly suggests that having access to a choice of media fosters enthusiasm for learning, and often amongst more reluctant students.

Motivation is more fully discussed in an earlier study by Hill, Wiley, Nelson and Hans (2004). They link motivation to the feedback mechanisms observed in four defined categories of interaction discussed in the Review of Literature, Chapter 2. Their categories are: *learner-instructor*, *learner-learner*, *learner-content* and *learner-interface*. Hill et al argue that the *learner-instructor* interaction provides motivation when it is needed and offers the most direct mechanism for feedback and arguably for motivation. It is observed in the data, particularly where the interviewees are describing interactions with individual students, be it face-to-face or online. The *learner-instructor* component of motivation is supported by the ARCS model of Keller and Suzuki, where satisfaction (S) coming from timely and positive feedback can motivate the learner to apply what is learned to other situations.

The *learner-learner* interaction, Hill et al (2004) contend, promotes the exchange of ideas amongst students. The data suggests that with the widespread use of chat rooms and forums, and considered in conjunction with Bandura's (1971) Social learning Theory, the *learner-learner* interaction has the potential to be an even greater motivator than the earlier Hill study could have predicted. The motivating power of the *learner-learner* interaction is also supported by the ARCS model of Keller and Suzuki where satisfaction (S), resulting from positive social experiences can motivate learners by giving them the confidence (C) to make judgments about what they have observed.

The *learner-content* interaction, in the Hill et al (2004) study, defines the learning process and includes the 'plan' for providing resources and activities. Both resources and activities feature strongly in the curriculum authority website which includes information maps, assessment criteria, practice assessment activities and marking rubrics. Hill et al, like Ally (2004), argue that this level of learner access to content offers students the opportunity to choose the direction their learning will take. For Ally this is not just a mechanism to motivate students

but a key element to be considered in the development of learning environments that offer learners autonomy.

Hill et al (2004), writing a decade before the widespread uptake of the Internet or mobile communication technology, describe the *learner-interface* interaction as the learner's ability to use the hardware and software delivering the course. The data collected from participants suggest that this is still a helpful category, if the notion of a learner's use of hardware and software is understood to mean 'extract and evaluate the information he/she requires to solve a problem'. The *learner-interface* component of motivation is then arguably supported by the ARCS model of Keller and Suzuki (1988), where motivation comes from establishing the relevance (R) to the learner, of what is learned.

The ARCS model also identifies attention (A) and confidence (C) as components of motivation. Elements which Hill et al (2004) and Keller and Suzuki (1988) believe motivate learners are found in the online learning material in the data of this study. Almost universally, each learning activity examined has an activity at the start to capture the learner's attention (A) and sequences tasks from simple to complex so that learners achieve success and gain confidence (C). The online learning material collected from, and described by, participants in this study, utilizes the design features Ally associates with CPLT.

In the design of my study, the CPLT component of the theoretical construct is largely restricted to an examination of the online learning material. The importance of the influence of students' awareness of their own thinking is not in the scope of the research design, but it is not underestimated. As Gredler (2004), contends in her discussion of Vygotsky's ideas, learners interacting in simulated and games environments, "cannot develop advanced cognitive and self-regulatory capabilities unless they develop conscious awareness of their own thinking" (p. 579). Walpole and Smolkin (2004) link the process of constructing knowledge to the processes which help students develop an awareness of their own thinking. Walpole and Smolkin contend that asking students to explain the construction of the pages with questions about the labels chosen to illustrate images for example, could be "used to start metacognitive discussion that would teach students to make purposeful text processing decisions . . ." (p. 208). This type of interaction is found in the data and is consistent with the notion of learners developing a conscious awareness of their own thinking. It also reflects a call by Gredler for the same type of teaching when she argues that, while gamers are striving to find solutions to virtual problems, they are not necessarily aware of their thinking. The influence of CPLT on the online learning environment in general is beyond the scope of this

study. However, its relevance and importance to online learning examined in this study is not underestimated. Moreover, Gredler's contention that the development of virtual learning environments has to take account not only of the desired learning outcome, but also of simulation and its associated context, is considered in the Conclusions, Chapter 6

In summary, all participants describe online instructional materials that exhibit all of the features Ally (2004) expects in instructional material based on CPLT, be it commercially produced software packages, online curriculum material for Year 12 VCE Information Technology displayed on a government website, or learning activities created by participants. In the next section the findings across all cases of features Ally (2004) expects to find in online instructional material based on Constructivist Learning Theory, are discussed.

5.1.2.3 Constructivist

Constructivist Learning Theory according to Ally (2004) contends that "learners learn best when they can contextualize what they learn for immediate application and when they learn to acquire personal meaning" (p. 7). The features he expects in an online learning environment based on this learning theory include: strategies to make learning an active process; opportunities for learners to construct their own knowledge; and an environment that encourages collaborative learning. The occurrences across cases of these features are set out in Table 5.3 below, and discussed in this section.

Table 5.3 Cross-case Summary: Features of Constructivist Observed in Online Learning Material

Features Ally (2004) expected in a learning Environment based on Constructivist Learning Theory	Features found							
	Catherine	Alan	Margot	Bill	Gary	Daniel	Louise	Robert
Strategies to make learning an active process.	1	2	1	2	1	2	1	1
Opportunities for learners to construct their own knowledge.	1	1	1	1	1	1	1	1
An environment that encourages collaborative learning is promoted.	1	1	1	1	1	1	1	1

Legend: Frequency of Observed Characteristic in Data

Not Observed	Infrequently Observed	Observed	Frequently Observed
	1	2	3

The data evidenced many strategies to make learning an active process, or to help students make what Ally (2004) describes as “personal interpretation and relevance” (p. 19). In the most striking example, students negotiated with one participant, to add games and chat rooms to online learning activities. The participant’s concessions to the students’ requests were steps towards collaborative activities, but they were added as rewards for tasks completed, and not integrated into the tasks to address VCE learning outcomes. There are many other examples in the data where chat rooms, forums and WIKIs are integrated into online collaborative tasks as part of the learning activity. The most frequently occurring online communications to facilitate group learning were between students in the same classroom. In one instance, learners were asked to text each other as part of recording activities in a research project. The participant expected this experience would lead them to build their own learning networks.

The data also evidenced what Ally (2004) described as “opportunities for learners to construct their own knowledge” (p. 19). He believed that information contextualized by the learner is preferable to that contextualized by the instructor for his/her own purposes. This idea concurs with von Glasersfeld (1990) who as noted in the Literature Review, Chapter 2, states that “knowledge is under all circumstances constructed by individuals . . . as an adaptation to their subjective experience” (p. 4). The von Glasersfeld contention is beyond the scope of this research. However, Ally’s contention that the Internet gives students opportunities to experience information first-hand, and contextualize it for themselves, is supported by the data. There are anecdotes of students accessing technical specifications of hardware and software directly from the manufacturers’ websites and downloading opinion pieces pertaining to the ethical use of technology. It is this unmediated access to information that arguably offers learners the chance to construct their own knowledge and adapt it to their individual needs.

All participants created online environments to foster collaborative learning where students could learn from each other, or in Ally’s (2004) words “use the strengths of other learners” (p. 19). Examples of collaboration in the data include: teams of students conferring on scientific observations by email; students developing online tutorials while working together in the same classroom; groups of students designing and implementing forums and WIKIs for more junior classes; and students uploading and sharing their video reports via interactive whiteboards, and via their personal mobile phones, tablets and wireless laptops. Observations and predictions by the interviewees suggest that the widespread uptake of social media by students is driving collaborative learning both in the classroom and outside normal school hours.

In summary, all participants described online learning activities in their VCE classes that illustrated features Ally (2004) expects in an online environment based on Constructivist Learning theories. In this section, the data across the cases has been examined through the lens of the three major learning theories, with the following observations. Participants and their VCE students had access to the curriculum information Ally (2004) expected to find in an online learning environment based on Behaviourist Learning Theory; participants used online instructional material with all the features that Ally expected to be found in online instructional material based on Cognitive Learning Theory; and participants included online oncampus collaborative learning activities consistent with Constructivist Learning Theory in their teaching repertoire. A summary of the artifacts collected from and/or referred to by each participant is presented in Table 5.8 (Appendix I).

In the next section, findings across the cases were examined for evidence of influences of the Internet on participants' teaching practice.

5.1.3 Education and the Internet

The findings from the cross-case analysis of the themes which emerged from the 'Education and the Internet' sections of the individual cases are examined in relation to three areas which are the focus of this study, namely: the VCE; online instructional material; and an online oncampus learning environment.

The data collected from each participant were examined with a view to understanding what the Internet had meant to each person. A number of themes emerged from each case and these were identified in the individual Case Reports, Chapter 4. When these themes were examined following the process for multiple case study analysis set out in Stake (2006), three cross-case themes were identified. These themes suggest the Internet offered participants enhanced access to information, opportunities for collaboration beyond the school and the opportunity to become independent learners.

The Internet enhanced access to subject-appropriate experts and information. All participants gained access to valued online resources that they would not otherwise have had, or would otherwise have had to a lesser extent. This included high quality, online interactive instructional material created for the VCE study and the opportunity to engage in real-time discussions at any time of the night or day. The interviewees could refer students to expert advice in real time, when it was needed to solve IT problems. The online resources were

available in a variety of modes appropriate for various learning styles. All participants subscribed/contributed to an email list for VCE IT teachers enabled by the Internet.

The Internet offered learners control of the learning environment. Hill, Wiley, Nelson and Han (2004) contend that the web “offers much more learner control than other systems or educational software” (p. 435), and this is supported in the data. The Internet has extended learner access to the VCE academic regulations and made the VCE curriculum equally transparent for students, teachers and parents. Participants used the Internet to link the entire VCE curriculum, in a standardized format, into their schools’ intranets, so that academic regulations, course details and assessment requirements were available via whiteboards or overhead projectors in every classroom. By these actions the participants arguably demonstrate an understanding of Hill et al’s (2004) contention, that extending control to learners is critical in developing an effective setting for learning.

The Internet provided opportunities for collaboration beyond the school. The data did evidence awareness of Hill et al’s (2004) notion of ‘social context’, or consideration of the possibility that the Internet “may not be culturally neutral” (p. 435). One participant joined the BeyondBorders program to form learning partnerships with schools located in NSW and France and recounted interactions between students that suggested that learners felt they were learning together. Another based her collaborations on an earlier ham radio project with Russian cosmonauts. She encouraged her students to use social media to communicate with and learn from other nationalities. In both of these collaborative activities the data evidenced students expressing the feeling that other learners shared the learning space, and more importantly, concurring with Hill et al’s (2004) findings, that audio responses from online learning partners “engendered a sense of presence” (p. 435).

The Internet also offers tutorials in a range of learning environments and modes of instruction. This allows teachers to act on the Gardner (1983) theory of ‘Multiple Intelligences,’ and to refer students to appropriate online material. Gardner contends that intelligence in an individual exists as “one or more basic information-processing mechanisms which can deal with specific kinds of input” (p. 64), and as a consequence, each individual has a preferred learning style. All participants described students using tutorials that suited their preferred learning styles. This is not surprising as a number of Victorian Secondary Colleges had professional development programs within broad curriculum strategies that aimed to adopt Gardner’s ideas. This included programs to help students think from different perspectives, based on the ideas of De Bono (1986).

The Internet required the eight teacher participants to become learners. All used the Internet to collect and share resources. They contributed regularly on the VCE IT teachers email list, joined threaded discussions to argue over interpretations of technical concepts and commented on any changes in the content of course outlines. When new teachers asked for help they posted exemplar online lessons and practice assessments along with advice. The email list was monitored for the duration of this study, and can be described variously as an environment for collaborative learning among teachers, a repository of online resources available to all VCE IT teachers and a motivating influence for teacher-learning.

In summary, the Internet enhanced the participants' access to other VCE IT teachers, their experiences in teaching Year 12 VCE IT and the availability of appropriate online instructional material. It extended both the participants' and their students' access to academic regulations, course outlines, and assessment marking guides. It provided opportunities for collaboration between the participants and other teachers the participants and their respective students, the VCE students and other students in other classes and also in classes beyond the school. Finally, the widespread everyday use of the Internet by the participants and their students had dramatically increased the requirement that the participant teachers become learners. This concurs with Kukulska-Hulme and Petit's (2009) observation that "learners are often able to contribute more actively to developing innovative educational uses of technology as they interweave them with other aspects of their lives" (p. 136).

Chapter 6 Conclusions

6.0 Introduction

The final chapter of this research draws together the major conclusions from Case Reports, Chapter 4 and the Cross-Case Report, Chapter 5. The conclusions represent what Stake (2006) describes as the “multiple perceptions” (p. 83) of the participants. Following the processes set out in Stake, the interpretations are based on the participants’ ‘thick descriptions’ of three main elements of the research question. These are: the VCE IT curriculum; online instructional material; and the oncampus and online learning environment. The processes of synthesizing the findings and presenting what Kervin, Vialle, Herrington & Oakley (2006) describe as “offerings or propositions from the study” are formed into conclusions and presented under the headings of emergent themes, theoretical constructs and the impact of the Internet.

To reiterate, the context of the study commenced with a preliminary field work phase. The *Information Technology VCE Study Design* VCAA (2006a) in Victoria, Australia was identified as a key document. This Study Design document mandates that courses must be developed within a framework of areas of study, outcome statements and key knowledge and skills. Interviews with VCE information technology teachers during the field study indicated that VCE information technology teachers were constrained by the academic regulations and learning outcomes of the VCE. The participants selected and created online learning activities and developed the infrastructure for online oncampus learning. My study was informed by Ally’s (2004) study *Foundations of Educational Theory For Online Learning* of the three selected schools of thought on learning: Behaviourist; Cognitive and Constructivist. In particular, his conclusion in the chapter entitled *Role and Function of Theory in Online Education Development and Delivery*, that “[t]he online developer must know the different approaches to learning in order to select the most appropriate instructional strategies” (p. 6). For a particular teacher, the teacher’s approach to teaching and learning may have an impact on the design of online instructional material utilised and the oncampus online learning environment created. For example, there are instances where the teacher’s preference for one learning theory influenced the mode and extent of online activities selected to address the learning outcomes and/or the online oncampus environment envisaged for the whole school.

6.1 Research Question

The widespread uptake of computers, the Internet and mobile technologies has arguably given VCE information technology teachers the impetus to develop online instructional material to fit with prescribed learning outcomes and infrastructure to deliver online instructional material oncampus.

The main research question proposed was: Are the major learning theories of the late twentieth century (Behaviourist; Cognitive; and Constructivist) evident in the online learning materials of VCE online oncampus learning environments?

To address this question the design for this research utilized components of each of these three schools of thought as the theoretical constructs through which data collected from the participants were examined. The findings from the individual case reports (Chapter 4) were then analysed as a multiple case study analysis (Cross-case Reports, Chapter 5). The findings were grouped and rated according to their importance for understanding the multi-case themes and categories, in particular how they relate to the main research question. Findings and interpretations, along with excerpts from related data sources, have already been presented and discussed in Chapter 5.

6.2 Summary of Main Conclusions

6.2.1 Emergent Themes

This section presents conclusions based on findings derived from three overarching themes that emerged during the analysis in Cross-case Reports, Chapter 5.

Conclusion 1

The online *VCE Information Technology Study Design 2007-2010* VCAA (2006a) conforms to the design principles associated with Behaviourist Learning Theory. As a consequence, the teachers who delivered the content set down in the *Information Technology VCE Study Design* document extended the Behaviourist principles to their own online learning material.

The first theme from which the conclusion is drawn, refers to the impact of the structure and content of Victorian Certificate of Education (VCE) course materials upon information technology teachers' classroom teaching. The VCE is a credentialed study which offers students the opportunity to achieve learning outcomes to a designated standard and gain an Equivalent National Tertiary Entrance Rank (ENTER which has changed to ATAR Australian Tertiary Admissions Rank and at the state level VICTER). The Victorian

Curriculum Assessment Authority (VCAA) sets out what students are expected to be taught in direct and unambiguous statements. The School Assessed Coursework section of the *VCE Assessment Handbook Information Technology 2007-2010* VCAA (2006b), for example, opens with the statement: “Teachers will provide to the Victorian Curriculum Assessment Authority (VCAA) a score for each outcome in a unit, . . . based on the teacher’s assessment of the level of performance of each student on the outcomes specified in the study design” (p. 13). The areas of study set an organisational context for each learning outcome and the key knowledge and skills list specific components of a computerised information system that will be assessed. The content and structure of the VCE online curriculum document are consistent with design principles Ally (2004) expects in an online course based on Behaviourist Learning Theory. The VCE information technology teachers deliver the prescribed content via their respective schools’ intranets using the same design principles they see in the online study design. Learners are informed of what knowledge and skills are expected to be learned, how they will be assessed and how their achievement will be measured.

Teachers, students and parents can directly access the *Information Technology VCE Study Design* VCAA (2006a) via the Internet and/or schools’ intranets. The online learning activities created by the teachers fit into the structure created by the curriculum authority and as a consequence the design is extended to the schools’ intranets. By these mechanisms the content, within a structure that preserves that of the VCE online curriculum document, is conveyed to classrooms via overhead projectors and interactive whiteboards. Learners are informed of what is expected, and tested to measure achievement. They are provided with instructional material sequenced from simple to complex and with detailed feedback that allows them to check their own progress.

Conclusion 2

The Internet allows VCE information technology teachers to select material that suits their own preferred styles as teachers/learners. As a consequence they tended to provide online learning activities in a variety of modes and allowed the VCE students to select materials in the students’ preferred learning styles.

The second theme, from which this conclusion is drawn, refers to the significance of the variety of online instructional material available on the Internet and the impact upon information technology teachers’ classroom teaching. The Internet is rich in all modes of online instructional material and it provides examples of strategies to address different modes of learning. VCE information technology teachers are aware of the need to address different

learning styles and used the Internet to locate learning activities that catered for ‘spatial’ and ‘interpersonal’ intelligences as well as for ‘linguistic’ and ‘logical-mathematical’ intelligences (Gardner, 1983). The teachers’ experiences in finding appropriate instructional material for themselves have added to their appreciation of having access to activities in a variety of modes. YouTube, for example, is cited as an effective multimodal resource used by VCE information teachers for their own instruction, but not included in the online oncampus learning activities because the Victorian secondary school colleges have policies that prevent students accessing the site.

Conclusion 3

VCE information technology teachers had personal enthusiasms for various communication technologies. Their preferences for particular technologies influenced the online oncampus learning environment they created.

The third theme from which this conclusion is drawn refers to the influence of teacher preference for a technology in the online oncampus learning environment and the impact of this upon information technology teachers’ classroom teaching. The VCE information technology teachers created online instructional material for their classes and strove to keep abreast of local and broader community demands for learners to have access to the latest mobile communication technologies. School administrators gave VCE information technology teachers responsibility, in varying degrees, for developing the infrastructure to deliver online material oncampus. There were instances for example where participant teachers created complete automated learning environments that could be accessed via mobile technologies. Findings in the data indicate that where the secondary college gave priority to feedback in the learning process, the information technology teacher used his/her preferred mechanism for online communication to build online reporting/feedback into the school’s online curriculum delivery software. Examples of online reporting included providing menu options for both formal and informal procedures using the school’s intranet. In other instances teachers accessed social media sites already used by the VCE students.

6.2.2 Theoretical Constructs

This second section presents conclusions based on findings as they have been processed using theoretical categories derived from design principles associated with Behaviourist, Cognitive and Constructivist learning theories. The use of these categories in the development of online instructional material is set out in two reviews of research: Foundations of Educational Theory for Online Learning by Ally (2004), and Behaviourism and Instructional Technology

by Burton, Moore and Magliaro (2004). To summarize their findings, Ally argues that “as research progresses new theories are evolving that should be used in developing online material” (p. 6). Burton et al assert that Behaviourist theory has contributed to the development of instructional technology. They identify Respondent learning (Methodological Behaviourism), Operant Conditioning and Observational learning as the concepts they use to frame their review.

Using the above theoretical constructs, the data collected in the study were examined for manifestations of design principles Ally (2004) and Burton et al (2004) associated with Behaviourist, Cognitive and Constructivist Learning Theories. Conclusions drawn from findings are presented under those headings in the next section.

6.2.2.1 Behaviourist Learning Theory

Conclusion 4

Behaviourist Learning Theory, which features strongly in the online learning environment created by the curriculum authority (VCAA) for the VCE Information Technology study, suits the teachers’ development of new instructional material for new delivery modes. This theory provides a proven framework of articulated external standards in which the teachers can operate.

Evidence in the responses from information technology teachers and observations of the content of online curriculum documents created by the information technology teachers and by the curriculum authority supports this conclusion. The data indicate that the content of course outlines and the structure of the course material placed on the schools intranets exhibit the design principles Ally (2004) associates with Behaviourist Learning Theory. In some cases, the external standards derive from the school’s administration policy to introduce school-wide overhead projectors, wireless laptops and in some instances fully interactive whiteboards. In these examples the participants oversee the delivery of online instructional material and the oncampus learning environment as it evolves. Examples of their responsibilities include selecting software and hardware, providing PD for staff and developing and evaluating strategies to ensure purchases meet school community objectives.

The online instructional material created and /or selected by the information technology teachers to address the VCE learning outcomes exhibit design features associated with Behaviourist Learning Theory. These include respondent learning and its subcategory

Methodological Behaviourism, Operant Conditioning and Observational Learning. Where the teachers mostly allowed students to select their own mode of instruction within the Behaviourist framework of the VCE learning outcomes, there were examples of online activities designed to promote complex learning, problem solving and the capacity to transfer learned skills and knowledge to new situations. In the instances where there were examples of computerized instruction, with automated monitoring, assessment and reporting which is reminiscent of Methodological Behaviourist Learning Theory, the information technology teachers were encouraged by their students to provide forums and chat sites. From the above example, this suggests that these teachers, in response to student behaviour/requests, were incorporating design principles associated with Observational Learning and perhaps moving towards design principles based on Bandura's (1971) Social Learning theory.

6.2.2.2 Cognitive Psychology Learning Theory

Conclusion 5

The design features Ally (2004) associates with Cognitive Psychology Learning Theory underpinned the instructional material sourced from the Internet and/or created by the information technology teachers and gave them the confidence to provide instruction for a variety of learning styles and in a range of modes.

Evidence in the artifacts collected from information technology teachers and observations of the design features recommended for online instructional activities in professional development programs created by the curriculum authority indicated the following important features. The placement of headings, labels and images is important. The pacing of steps in a sequence of instructions is important. Furthermore, colour groupings chosen to display the information/instructions placed on the schools intranets were important. These features exhibit the design principles Ally (2004) associates with Cognitive Psychology Learning Theory. The online material was created sometimes by the participants and sometimes sourced from the Internet. Where the instruction gives priority to memory there are examples of learning material that uses colour and placement to assist the transfer of information to working memory and information maps and groupings of generalised categories to help learners transfer new information to long term memory. In situations where thinking and reflection was required the activities included features which allowed learners to select according to their preferred learning styles. These design features include:

- activities based on their preferred learning styles;
- the option of an instructor being present or not; and
- the choice of textual, visual and/or verbal modes of communication.

Where participants gave priority to creating and or sourcing instructional activities to motivate students, the most influential design feature was the individual learner's preferred learning style and mode of delivery. The data also suggest that when teachers encourage VCE students by allowing them to choose activities for themselves, the teachers fit Keller and Suzuki's (1988) ARCS model for designing/offering material to motivate learners.

6.2.2.3 Constructivist Learning Theory

Conclusion 6

Constructivist Learning Theory provides a pedagogical framework for VCE information technology teachers to create a stable, online, collaborative environment where students already immersed in social media culture can creatively address the prescribed learning outcomes.

The responses from the VCE information technology teachers indicated that the online oncampus learning environments of secondary colleges were under pressure to change in response to a demand for the inclusion of mobile communication technology and social media. The data recorded online instructional material that supported collaborative learning and co-construction of knowledge, and fit with the design principles Ally (2004) associates with Constructivist Learning Theory.

The extent to which social media and mobile technology are included in the curriculum is determined by the school community. In the instances where the school encouraged the use of technologies such as mobile phones, tablets and wireless laptops, they were used in class and on campus to foster collaborative learning. Examples from the data which suggest co-construction of knowledge include students designing and implementing forums and WIKIs, and sharing their video reports via interactive whiteboards, personal mobile phones, tablets and wireless laptops. The data indicated that the widespread uptake of social media by students is resulting in more online oncampus learning activities underpinned by design principles based on Constructivist Learning Theory. In particular, features of Constructivist Learning Theory that promote collaborative learning and co-construction of knowledge are found in activities designed for both in the classroom and outside normal school hours.

6.2.3 The Impact of the Internet

Conclusion 7

The Internet gave each VCE information technology teacher the experience of being a new learner at the height of their professional careers. These teachers used the Internet to collaborate and to source information when they needed it. As a consequence these teachers encouraged each student to use the Internet to find learning material that suited the student's preferred learning style. This experience is a liberating and challenging consequence for students in an Information Age.

In summary, during the time period covered by this study, the Internet has enhanced the participants' access to other VCE IT teachers. They easily shared their experiences in teaching Year12 VCE IT and found appropriate online instructional material. It extended both the participants' and their students' access to academic regulations, course outlines, and assessment marking guides. It provided opportunities for collaboration between the participants and other teachers and the participants and their respective students. Additionally, the VCE students communicated with other students in other classes and also in classes beyond the school. Finally, the widespread everyday use of the Internet by the participants and their students dramatically increased the requirement that the students become independent learners.

6.2.4 Contribution of the Study

This study highlights the importance of taking into account:

- teacher knowledge
- the demands of information technology for Professional Development
- changing technology.

These constituents impact on the online learning material of the 21st Century.

6.2.5 Limitations

This is a small qualitative case study based on data collected from 8 participants. Data were collected and coded in the years 2006-2010. A theoretical framework derived from three theories of learning (Behaviourist, Cognitive and Constructivist) discussed in research by Ally (2004) and Burton, Moore and Maglio (2004) and other theories of learning, largely restricted to these, was used to examine the data. Conclusions drawn from the analysis of responses are generalisations based on the perceptions of 8 teachers of VCE Information Technology. A review of new literature in the field post data collection and analysis published

in the years 2010-2013 points to rapidly changing knowledge in the field. The findings therefore relate to a four year period and are bounded by the limitations of a theoretical construct, data collection and analysis processes set down in the Methodology.

6.2.6 Recommendations for Further Research

As the study progressed, the emergent theme ‘teachers as learners’ suggested a direction for future research. Two of the theories of learning discussed briefly in the Literature Review, Chapter 2, were considered as theoretical constructs that might help future researchers understand how the Internet influenced ‘teachers as learners’. The first is Social Learning Theory which derives from the Observational Learning component of Behaviourist Learning Theory. The second is Activity Theory which derives from CPLT.

A preliminary examination of data using the theoretical constructs of Social Learning Theory and Activity Theory suggests that these would be of value in future research. This study was not framed to explore these observations in depth, but they are flagged here as directions for further research.

6.3 Concluding Remarks

The information technology teachers selected for this study are innovative practitioners who are working within in a state-wide curriculum framework that is organised to provide unambiguous learning outcomes for an accredited certificate of education. They have, in response to a rapid uptake of communication technology by their teaching institutions and their students, become life long learners. The findings of this research suggest that information communication technologies and teaching practices influence each other, and that information technology teachers rely on pedagogies that are familiar. They are at the same time, willing to adapt evolving pedagogies as new needs arise.

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Appendices

Appendix A

RMIT Human Research Ethics Sub-Committee (HRESC) Form:
Seeking Approval to Conduct Research.

Note: Minor thesis title changes occurred in 2007

RMIT HUMAN RESEARCH ETHICS COMMITTEE

Prescribed Consent Form For Persons Participating In Research Projects Involving Interviews, Questionnaires, Focus Groups or Disclosure of Personal Information

PORTFOLIO OF	Design and Social Context
SCHOOL/CENTRE OF	Education
Name of participant:	<Name of Teacher>
Project Title:	Authors', Publishers' and Students' Perceptions of the Design and Usage of Learning Materials in a VCE Online Educational Environment in the 21st Century
Name of investigator: (1)	Kris Thatcher Phone: <My Phone>

1. I have received a statement explaining the interview/questionnaire involved in this project.
2. I consent to participate in the above project, the particulars of which - including details of the interviews or questionnaires - have been explained to me.
3. I authorise the investigator or his or her assistant to interview me or administer a questionnaire.
4. I give my permission to be audio taped ☐ Yes ☐ No
5. I give my permission for my name or identity to be used ☐ Yes ☐ No
6. I acknowledge that:
 - (a) Having read the Plain Language Statement, I agree to the general purpose, methods and demands of the study.
 - (b) I have been informed that I am free to withdraw from the project at any time and to withdraw any unprocessed data previously supplied.
 - (c) The project is for the purpose of research and/or teaching. It may not be of direct benefit to me.
 - (d) The privacy of the information I provide will be safeguarded. However should information of a private nature need to be disclosed for moral, clinical or legal reasons, I will be given an opportunity to negotiate the terms of this disclosure.
 - (e) The security of the research data is assured during and after completion of the study. The data collected during the study may be published, and a report of the project outcomes will be provided to PhD, RMIT, and possibly conference papers and journal publications. Any information which may be used to identify me will not be used unless I have given my permission (see point 5).

Participant's Consent (aged 18 years and over)

Name:	_____	Date:	_____
	(Participant)		
Name:	_____	Date:	_____
	(Witness to signature)		

Participants should be given a copy of this letter

Any complaints about your participation in this project may be directed to the Secretary, RMIT Human Research Ethics Committee, University Secretariat, RMIT, GPO Box 2476V, Melbourne, 3001. The telephone number is (03) 9925 1745.

Details of the complaints procedure

Appendix B

Plain Language Statement: Teachers Form

Teacher

Note: Minor thesis title changes occurred in 2007



Design and Social Context Portfolio

School of Education

Plain Language Statement to be used in a research project involving human participation

Dear <Name of Teacher>

My name is Kris Thatcher

I am undertaking a PhD at RMIT University. The title of my research is-
Authors', Publishers' and Students' Perceptions of the Design and Usage of Learning Materials in a VCE Online Educational Environment in the 21st Century

Anecdotal evidence and research literature indicates that many teachers prepare learning material which their students access online and on-campus. This research aims to increase understanding of this rapidly developing field where teachers are constantly trialling and modifying teaching strategies and online instructional material for students who are studying at the VCE level.

This is a study of the teachers who are authors of online learning materials created specifically for VCE Information Technology students working on-campus. Eight classroom teachers who produce the material for Information Technology, Software Development and IT Applications as part of the Victorian Certificate of Education (VCE) will be interviewed. Three publishers of commercial online learning material for the VCE will also be interviewed. Data will be collected during the years 2006 to 2008 and the report of findings presented in a PhD thesis in 2011.

I would like to invite you to be part of this study. If you agree to participate a taped interview of approximately one hour will be conducted at your school. You will be given the transcript to annotate and edit should you wish to alter, delete or clarify anything. The data collected from interviews, and surveys will be coded and pseudonyms used to protect your anonymity. Your participation is voluntary and you will be able to withdraw at any time.

Further information can be obtained from me on 039383-6164, email k_thatcher@hotmail.com.

Should you have any problems or questions you can contact my senior supervisor Associate Professor Heather Fehring on 0399257840, email fehring.heather@rmit.edu.au.

Kristine Thatcher

Any complaints about your participation in this project may be directed to the Secretary, RMIT Human Research Ethics Committee, University Secretariat, RMIT, GPO Box 2476V, Melbourne, 3001.

Appendix C

Letter Granting Approval to Use VCAA Material

The image of a letter granting permission to use VCAA material in this thesis in copies printed for the purpose of examination has been removed to comply with copyright.

Appendix D

Peer Audit of References from Transcripts of Interviews.

Catherine (ATran-842 to ATran850)

Catherine - Well the kids can just go through it, and it starts of with really **interesting stuff**, not boring.

And they teach me too, they say “we’ve got something to show you,” and they call me over and ...

Catherine – The kids loved it. Year 10 kids got into it straightaway. I had no queries about ‘how do you understand this?’ or ‘what does this mean?’ It was really well written, so that was great.

Alan (BTran-354 to BTran857)

Alan-And I do make it explicit and I’m trying to make them learn how to learn because in IT as I say to my kids in year seven . . . ‘what I’m teaching you once you finish school you’ll never used again.’ ‘So why are we learning it?’ ‘Well you’re learning it because . . . you need to learn how to **learn software**.’

Margot (CTran-498 to CTran505)

Well, the teacher came to me and said, “[Margot], what is a WIKI?” And I went through the whole thing and she didn’t understand a word. I said, “But the kids know what it is and they want one.” I said, “Okay, I’ve set you up one,”. So, I got the kids in class and I showed them it, and they immediately understood. One kid developed. I said, “Here, you’re on the controls. You’re the pilot” So he set up all the different things for forums, for all the different stuff that you have in Renaissance and . . . I said, “Do you need some forums on this stuff? . . .” And **kids contributed**.

Bill(WTran-74 to WTran80)

Bill-In terms of the MOODLE, MOODLE allows for WIKIs, it allows for blogs, it allows for quizzes, and it allows for submission of assignments, it allows for notes, it allows for homework pages. So I’ve got, my Year 12 one is especially useful, it’s got the full year’s course on there that’s there from the start of the year, all the key knowledge and the **key skills**. It shows in . . . it has a mapping to show which activities will address those key knowledge and key skills. And it has hyperlinks to worksheets, or PowerPoints, or quizzes and so forth.

Appendix D continued

Gary(GTran-759 to GTran-786)

Asking his colleague to confirm the value of interactive whiteboards in the classroom

Gary- . . people are springing out to get into rooms to use them.

Colleague- *I want to be in one. . . I used them last year. . . .*

Interviewer-Did you use them, like by interactive, did you use the internet at the same time?

Colleague- *I did, sometimes just a little recall, little maths applets to draw the curves here and show the sheets. You take a bit of time, you can't do too many complete sums and find the right. . . .*

Gary-Yes

But when you're, it's just that convenience.

Gary-Yes

Colleague- *Sometimes you might just use it for your own notes, but just to have that flexibility.*

Gary-Yes

Daniel(DTran-891 to DTran-896)

Daniel-so I've got my red car, I'll change it into a purple car and I left that bit there to point out if they wanted to, if they're not careful and lift their pen up you'll colour anything purple but if you hold it down you can just go straight over the whole lot and then re-colour that with the fence colour. And so then I have got a text behind layers so there's different layers with the text and so you can actually have different text effects in the poster.

Louise(LTran-255 to LTran-262)

Louise-And I used one with them earlier in the year that was, had lots of networking stuff on it, lots of flash animation and that sort of thing and they found that quite useful that someone had sent through the list and, but it reinforced learning, it didn't teach the content, we had already done the content, it was now about going on and having a look at that and I think it was random, multiple choice for a particular network and then it would draw the network or that sort of thing, and those sort of things just reinforce what they know . . .

Robert(RTran-808 to RTran-812)

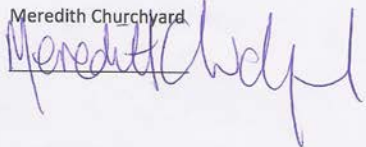
Robert-Kids nowadays are in a screen culture life, where they spend most of their time looking at text on a screen it would seem. My year 12 class, they were all on Facebook. I'm not into Facebook; I know if I get into it then it's going to be a real trap [laughs]. One of our other teachers accidentally accepted an invitation to Facebook from one of our current students thinking it was a past student.

Appendix D continued
Peer Audit

Data Audit for PhD Thesis Student Kristine Thatcher

Case Report	Table Number Quote Reference	Transcript Line Number
Catherine "interesting stuff"	4.4 A Tran 849	842-3.
Alan "learn software"	4.7 B Tran 356	357
Margot kids contributed	4.15 C Tran 501	504- 11 5
Bill key skills	4.18 E Tran 77	78
Gary complete sums	4.24 G Tran 773	774.
Daniel fence colour	4.27 D Tran 887	894
Louise(Greta) "reinforced learning"	4.33 L Tran 146	258
Robert not into Facebook	4.37 R Tran 12	810.

This is to confirm that I have selected the quotes in the case study reports listed above and recorded their line numbers in the transcripts of interviews from which they derive.

Meredith Churchyard Date
 3/4/14.

Note: The peer audit (shown above) identified two typographical errors in references to the transcripts of interviews. In Tables 433 and 437, (LTran-146) was corrected to (LTran-258) and (RTran-12) corrected to (RTran-810) respectively.

Appendix E

Standardised Questions
Handed to each participant at the start of the interview

Interview Questions

- 1. How many students in the IT VCE class?**

 - 2. How is the online learning material distributed on campus?**

 - 3. When did you start using online learning material?**

 - 4. What do you do now?**

 - 5. What do you see in the future?**
-

Appendix F

Implementing the VCE (selected screen shot from the CD)

[Year 12 IPM] VCAA CD ROM Implementing *VCE IT 2007-2010*, 2007, Retrieved
23/11/ 2006/, from

www.edulists.com.au/pipemail/ipm/2006-November/003624.html

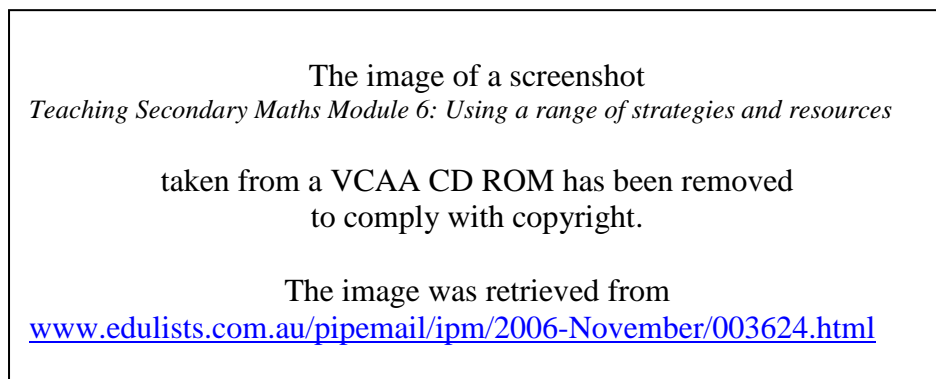


Figure Slide 12 Teaching Secondary Maths Module 6: Using a range of strategies and resources
Example: Percentages

Appendix G

Example of DigiLearn

DigiLearn <http://www.education.vic.gov.au/studentlearning/teachingresources/ict/learnobj.htm>

The image of a screenshot
Using Digital Learning Objects in Schools
has been removed
to comply with copyright.

The image was retrieved from
[http://www.education.vic.gov.au/studentlearning/teachingresources/ict/learnobj.
htm](http://www.education.vic.gov.au/studentlearning/teachingresources/ict/learnobj.htm)

Appendix H

Example of Inspiration

www.inspiration.com/Resources/Research

The image of a screenshot

Scientific Based Research on Graphic Organizers and Visual Learning

has been removed
to comply with copyright.

The image was retrieved from

www.inspiration.com/Resources/Research

Appendix I

Summary Tables Used in Cross-case Analysis

Legend: Frequency of Observed Characteristic in Data

Not Observed	Infrequently Observed	Observed	Frequently Observed
	1	2	3

Table 5.4 Cross-case Summary: Conditioned Responses in Instructional Material

Features of conditioned responses expected in instructional material	Features observed by the researcher when running the online learning activities							
	Catherine	Alan	Margot	Bill	Gary	Daniel	Louise	Robert
Noise	1	1						
Screen Alert	3	3		2		2		
Monitoring and Report	1	1		2		1		
Prize /Score	1	1						

Table 5.5 Cross-case Summary: Antecedents (cues or signals), Operands and Consequences Sequence

Features of Operant Conditioning Burton, Moore and Magliaro (2004) expected in instructional material	Features of Operant Conditioning							
	Catherine	Alan	Margot	Bill	Gary	Daniel	Louise	Robert
Complex Learning: “chained behaviours . . . the consequence [of one learning step] takes on a dual role and becomes the stimulus [for the next step] . . . relying on the learner building associations based on the simplest unit they have learned in an environment which provides contiguity and utilizes repetition” (p. 12).	3	1	1	2	1	1	1	1
Problem Solving: “tactical readjustment to changes in the environment . . . [a] trial and error experience . . . controlling the sequence of material, monitoring the student’s progress and providing appropriate help results in the learners ability to generalize (respond the same way to similar stimuli) and discriminate (respond differently to varied stimuli)” (p. 12).	1	2	1	2	1	2	1	3
Transfer: “involves the replication of identical behaviours from [one] task . . . to a new task that has similar elements” (p. 12). “discriminate and to generalize . . . central in the processes that enable learning to be adapted and transferred to other “environments (p. 12).	1	3	1	2	1	1	1	1

Appendix I continued

Legend: Frequency of Observed Characteristic in Data

Not Observed	Infrequently Observed	Observed	Frequently Observed
	1	2	3

Table 5.6 Cross-case Summary: Components of Observational Learning

Features Burton, Moore and Magliaro (2004) expected in instructional material based on Observational Learning	Features of Observational learning observed/evidenced across the 8 cases							
	Catherine	Alan	Margot	Bill	Gary	Daniel	Louise	Robert
<u>Attention</u> “observers sensory capacity (perceptual set) . . . Learners should be told why they should take a lesson so that they can attend to the information throughout the lesson” (p. 11).	1	1	1	1		1	1	1
<u>Retention</u> “response patterns and how they are represented in memory in symbolic form” (p. 11).	1	1	1	1		1	1	1
<u>Motor reproduction</u> “organisation of responses on the basis of feedback” (p. 11).	1	1	1	1		1	1	1
<u>Motivation</u> “evaluative judgments that learners make about what they have learned and how it will affect their performance” (p. 11).	1	1	1	1		1	1	3

Table 5.7 Cross-case Summary: Components of Methodological Behaviorism Observed Across Cases

Features of Methodological Behaviorism Burton, Moore and Magliaro (2004) expected in instructional material	Alan	Bill
Automated instruction: Training videos and audio visual instructional material computers provide control of the sequence of material	1	3
Online Q and A: Responses observed and analyzed. Acting as tutors, and they can be programmed to respond to learners' questions	1	3
Automated tutors: Email and video conferencing, computers determined when learners needed help, selected the type of help and used the Internet provide help	2	3

Appendix I continued

Table 5.8 Cross-case Summary of Artifacts and Observations

Participant	Artifacts	Observations
Catherine	Action Script tutorial Flash Classroom tutorial Kahootz learning activity Beyond Borders collaborative e-learning software	Tour of Classrooms Demonstration of collaborative software MOODLE platform Follow-up conversation about online assessment issues
Alan	Bryce tutorials Action Script 3 tutorials Beta testing reports Email attachments- online activities	Tour of IT office Conversations with IT technician Email responses to VCE curriculum issues Follow-up conversation about the value of Beta testing and other help file issues
Margot	CD of advice to teachers VITTA advice to teachers VCAA advice to teachers Email advice to teachers Krozier (2007)	Tour of IT office in follow-up informal interview MOODLE platform Demonstration of WIKI Email responses to VCE curriculum issues
Bill	CD of online VCE Course Email advice to teachers Krozier (2007) VITTA advice to teachers	Tour of IT office Demonstration of consoles monitoring college's intranet using MOODLE platform Conversation with IT technician using monitoring consoles.
Gary	PaperCut software DigiLearn software Inspiration software Edunet Math's applet that draws curves	Tour of IT office Trolleys of class sets of laptops Library shelves completely replaced by desk top computers MOODLE platform Conversation with math's teacher colleague about the use of math's applets
Daniel	Microsoft FrontPage tutorials Printer technical specification College Technology Report Email advice to teachers VITTA advice to teachers Inspiration software	Tour of IT office Examples of student individual work Examples of student collaborations Demonstration of online activities that use/create graphs and diagrams Blackboard Platform
Louise	Microsoft Excel tutorials Microsoft tutorials with audio and video options Email attachments of templates for VCE students to use for assessment reports	Interview conducted in researcher's office. Follow-up conversations by telephone Email responses to VCE curriculum issues Email advice to teachers MOODLE platform Follow-up conversation at curriculum centre
Robert	School resources policy School resources list	Tour of college intranet Colour scheme for school-wide curriculum documents MOODLE platform Examples of VCE Online learning activities